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ABSTRACT

"The Topic Is Sandy Hook" is an experiential 10-week program designed to provide special opportunities and educational experiences for 6th to 10th grade gifted and talented students. Sandy Hook, a natural resource in Monmouth County, New Jersey, is unique in its physical and historical features and provides an exceptionally rich environment in which students can explore and develop learning experiences related to energy, history, environment, engineering, marine science, aesthetics, and natural history. The guiding principle behind this program is discovery through varied activities, with each student having new and different learning experiences. Designed for teachers and students involved in the program, this guidebook includes information on criteria for selecting students, supervision, grading, transportation, emergency plans, equipment and clothing, weather, and first aid. For each unit in the program, informational and instructional materials for the students are presented, along with quizzes, follow-up suggestions, and homework assignments. The units are: (1) Diving into Marine Science; (2) Meeting Marine Life; (3) Marshes--The Most Productive Places in the World; (4) Down to the Sea in Ships; (5) Barrier Beach Botany; (6) Water and Waves; (7) The Moving Beach; (8) The Battle of Sandy Hook; and (9) S.O.S.--Save Our Shoreline. A variety of optional activities are also included. (EJV)

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THE TOPIC IS

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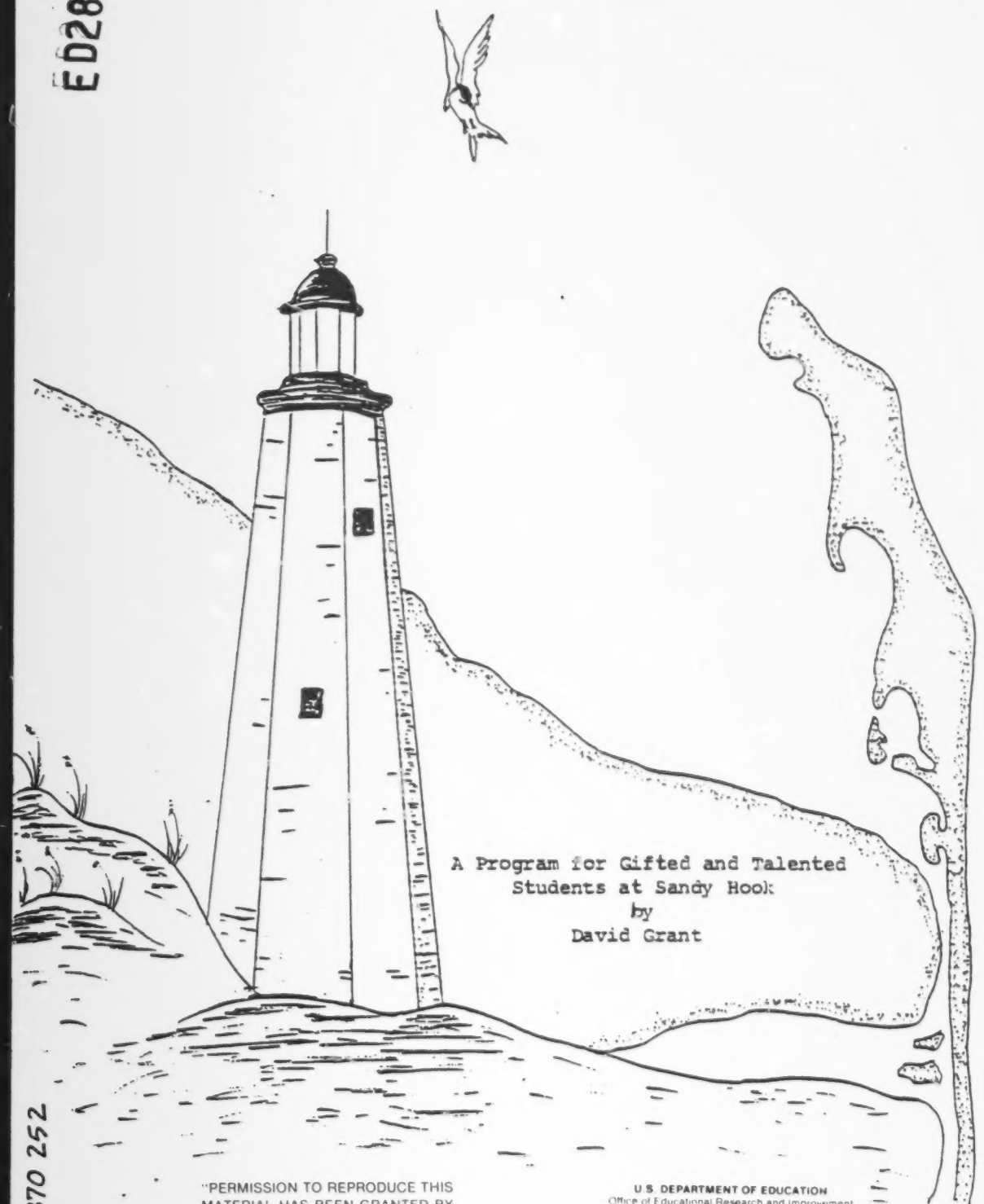

A Program for Gifted and Talented
Students at Sandy Hook
by
David Grant

JC 870 252

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THE TOPIC IS SANDY HOOK I

A Cooperative educational experience for gifted and talented students in the sixth through tenth grades. Developed by David Grant, The Monmouth County Gifted and Talented Program Coordinating Council, Monmouth County School Districts, and the Monmouth County Office of Education.

Coordinated By

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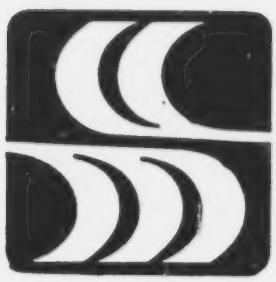


BROOKDALE
COMMUNITY
COLLEGE

THE TOPIC IS SANDY HOOK

An experiential 10 week program providing special opportunities and educational experiences for 6th-10th grade students identified by their districts as being exceptionally gifted and talented.

Sandy Hook, a natural resource in Monmouth County, is unique in its physical and historical features and provides an exceptionally rich environment in which students can explore and develop learning experiences related to energy, history, environment, engineering, marine science, aesthetics and natural history.

The guiding principle behind this program is discovery! Activities are varied and each student gains new and different experiences that encourage learning in a variety of ways and provides lasting memories and thoughts to explore in the future.

Special credit goes to David Grant for Curriculum development and the American Littoral Society, Natural Park Services, National Sea Grant Programs and others for use of their articles.

"The Topic is Sandy Hook I" is one of the many school programs for gifted and talented students that are now being expanded and coordinated by Community Services, Brookdale Community College, Lincroft, NJ 07738

IMPORTANT DETAILS TO ALL PARTICIPATING SCHOOLS

Criteria for Selecting Students

The district/school will have the responsibility for selecting the participating students. The selection process should include the students with a strong interest in marine-related sciences.

School Liaison

Each school must designate a staff member who is responsible for the students attending and who can be contacted by the project director regarding coordination and in case of emergencies.

Supervision

To help assure adequate adult supervision of students while at Sandy Hook, at least one adult should accompany each school group. If additional teachers wish to come with the students, to the weekly classes, they can do so at no additional cost.

When classroom teachers accompany students they also are better able to provide appropriate carry over that enhances the students learning experience between sessions as well as after completion of the program.

Discipline/Agreements

1. Students are to participate in every phase of the program.
2. Students must stay with the group and follow the directions of project teacher.
3. The project instructor will contact the district in the event that there are infractions to the rules that may endanger the safety and intent of the project. The instructor will recommend the dismissal of any student not abiding by the agreement. No refunds will be allowed to the district, however, the slot may be filled by another eligible student.

Grading

The district may elect to have the sudents graded by the project teacher, or not. Grades will be based on participation, assignments and notebook entries. The district must indicate its choice to the project manager and teacher before the start of the first session.

Transportation

The district is obliged to transport their own students to the program site. Districts may wish to coordinate transportation if arrangements can be made. Whenever possible we would appreciate it if the school bus/van could remain at Sandy Hook during the class session. Students explore different parts of Sandy Hook during the program and vehicular transportation saves the extra time needed to walk the longer distances and is expecially helpful when the weather is inclement.

Timing

One half-day a week (9 am-12:00 pm or 12:00-3:00 pm) for ten weeks in spring or fall. To provide all students with maximum time at Sandy Hook, we would like to start and end all programs on schedule. Will you please see that students arrive at the appropriate site location 10-15 minutes before their class is to begin and that buses/vans are available on site to pick up students at the end of each session.

Emergency Plans

Sessions will be held, as scheduled, unless really severe weather conditions are deemed to present a safety hazard. If that is the case, your school contact person will be notified by Brookdale. In all other cases students should come appropriately attired for the weather and the activities.

Location

Unless otherwise noted, all classes will start and end at Building #53 at Sandy Hook. When sessions are held off-site (e.g. boat trip and snorkel diving) directions will be providied in advance and the buses will proceed directly to these sites.

Equipment and Clothing

Students are to dress appropriately for an outdoor experience. It would be well to remember that Sandy Hook is generally cooler than the "mainland" so students should bring a variety of warm and protective clother. All equipment for individual experiences (e.g. snorkel masks, nets) will be provided.

Since this will be primarily an outdoor experience, students must be prepared to face the weather on each visit to Sandy Hook. Rainsuits should be brought during cool weather (after October 15), even if there is only a slight chance of rain.

Sneakers should be worn most of the time since we will generally be doing a lot of hiking around. Rubber boots are suggested on the following occassions: the marsh study, the boat trip, after October 15, if rain is expected. A ski hat or sun visor is also recommended depending on the season. It is advisable that students bring back-packs or gym bags with the following: a change of socks, extra sweatshirt, hat, snacks, towels, extra jeans or sweatpants.

Weather

It is usually windier and therefore cooler at the beach than even a mile inland - be prepared and dress appropriately. Assume we are going outdoors for at least 50% of the class, even on the most dismal of days. Plan to overdress in cool weather by wearing several layers rather than one heavy coat that provides for easily adapting to weather changes.

First Aid

It is recommended that each school send a first-aid kit on the bus.

The Topic is Sandy Hook program incorporates the following activities:

Week

1 Diving into Marine Science - Pool session explores human activities in the sea. The physical properties of seawater are explored - sound and light transmission, density, pressure, salinity, temperature. Safety and confidence-building around water will be stressed. Session is off Sandy Hook at indoor pool. Equipment, mask, fins, snorkel provided.

2 Meeting Marine Life - The estuary along Sandy Hook Bay is studied. Collecting by the students (this is wet work!). Goal will be to study the great variety of habitats available to coastal marine life.

3 Marshes - The Most Productive Places in the World - By studying nutrient cycling and physical parameters, and surveying population densities, the students will learn why these coastal areas are so valuable.

4 Down to the Sea in Ships - An onboard experience to collect and study deeper-water creatures, pollution, human impacts of the sea. Activities will be limited to protected Sandy Hook Bay waters. A US Coast Guard-approved vessel and crew will be used exclusively.

5 Barrier Beach Botany - An ecological view of the beach using the distinctive vegetation found here. Plant and animal adaptions to environmental stress will be observed.

6 Water and Waves - The physical and geological features of the shore. The generation of waves and currents and their effect on the coast.

7 The Moving Beach - The geological history of Sandy Hook. Dunes, beaches, sand and minerals, topography, map and chart reading.

8 The Battle of Sandy Hook - The military history of Fort Hancock. Life in the 1700's and 1800's is explored. Why was Fort Hancock built? Why was Sandy Hook chosen as a military reservation, and eventually as a park?

9 S.O.S. - Save Our Shoreline - Human activities along the shore. Engineering attempts to control the shore. Development pressure, preservation as parks, commercial use - these human factors will be considered in assessing the benefits and costs of living and working along the coast. Visit to Twin Lights Museum included.

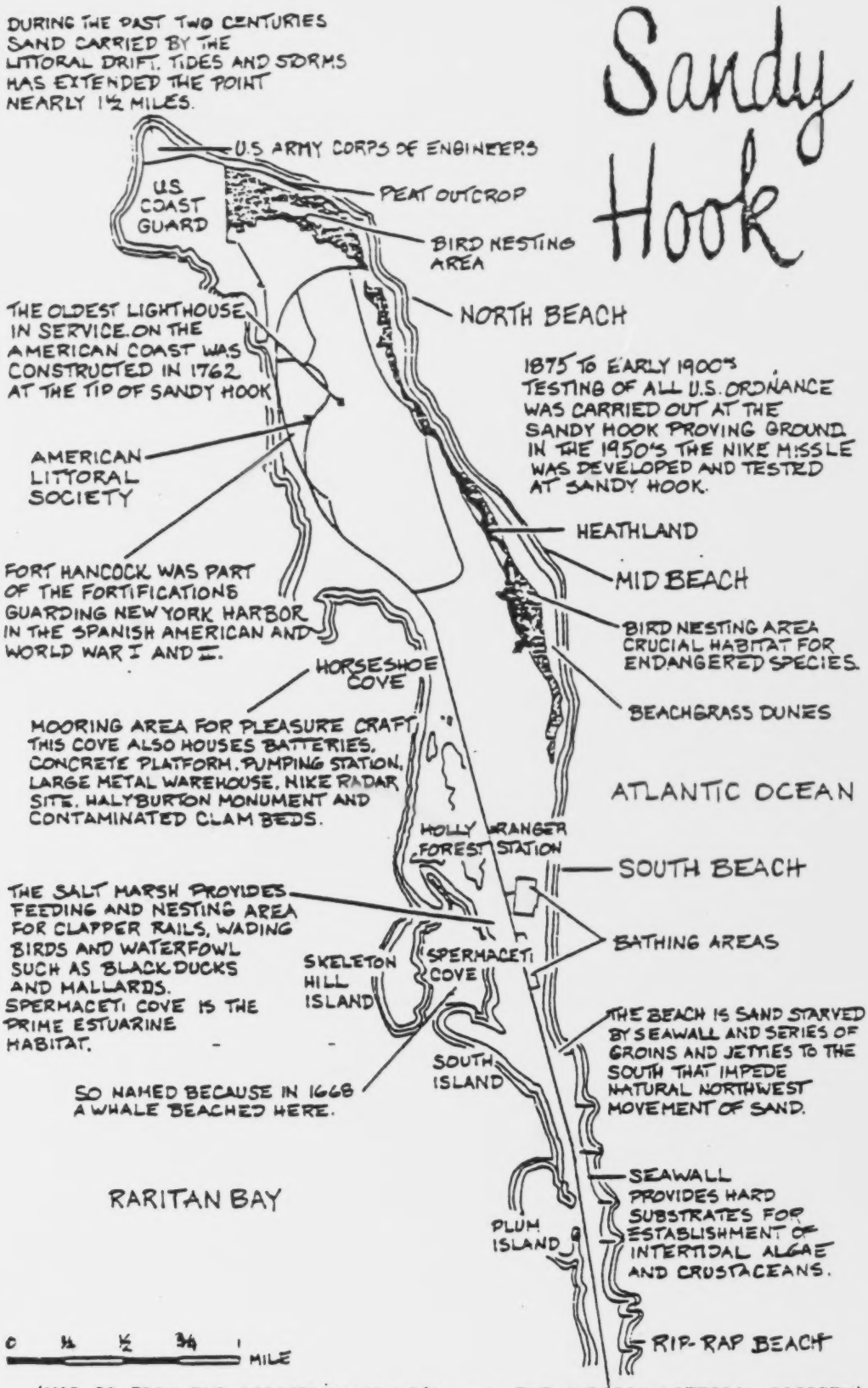
10 Optional Activity (varying with the season, weather, availability of facilities, etc.)

The Beach in Winter

Plankton - lab work with microscopes. The most fascinating and important feature of the ocean.

Arts and Crafts - teaching an awareness of environment through art. Japanese fish-printing, sand-casting, map-making, etc.

Sandy Hook


DURING THE PAST TWO CENTURIES SAND CARRIED BY THE LITTORAL DRIFT, TIDES AND STORMS HAS EXTENDED THE POINT NEARLY 1½ MILES.
U.S ARMY CORPS OF ENGINEERS
U.S. COAST GUARD
PEAT OUTCROP
BIRD NESTING AREA
NORTH BEACH
THE OLDEST LIGHTHOUSE IN SERVICE ON THE AMERICAN COAST WAS CONSTRUCTED IN 1762 AT THE TIP OF SANDY HOOK
1875 TO EARLY 1900'S TESTING OF ALL U.S. ORDNANCE WAS CARRIED OUT AT THE SANDY HOOK PROVING GROUND. IN THE 1950'S THE NIKE MISSLE WAS DEVELOPED AND TESTED AT SANDY HOOK.
AMERICAN LITTORAL SOCIETY
HEATHLAND
MID BEACH
FORT HANCOCK WAS PART OF THE FORTIFICATIONS GUARDING NEW YORK HARBOR IN THE SPANISH AMERICAN AND WORLD WAR I AND II.
BIRD NESTING AREA CRUCIAL HABITAT FOR ENDANGERED SPECIES.
HORSESHOE COVE
BEACHGRASS DUNES
MOORING AREA FOR PLEASURE CRAFT. THIS COVE ALSO HOUSES BATTERIES, CONCRETE PLATFORM, PUMPING STATION, LARGE METAL WAREHOUSE, NIKE RADAR SITE, HALYBURTON MONUMENT AND CONTAMINATED CLAM BEDS.
ATLANTIC OCEAN
HOLLY FOREST
RANGER STATION
SOUTH BEACH
THE SALT MARSH PROVIDES FEEDING AND NESTING AREA FOR CLAPPER RAILS, WADING BIRDS AND WATERFOWL SUCH AS BLACK DUCKS AND MALLARDS. SPERMACETI COVE IS THE PRIME ESTUARINE HABITAT.
BATHING AREAS
SKELETON HILL ISLAND
SPERMACETI COVE
THE BEACH IS SAND STARVED BY SEAWALL AND SERIES OF GROINS AND JETTIES TO THE SOUTH THAT IMPEDE NATURAL NORTHWEST MOVEMENT OF SAND.
SOUTH ISLAND
SO NAMED BECAUSE IN 1668 A WHALE BEACHED HERE.
SEAWALL PROVIDES HARD SUBSTRATES FOR ESTABLISHMENT OF INTERTIDAL ALGAE AND CRUSTACEANS.
RARITAN BAY
PLUM ISLAND
RIP-RAP BEACH
0 ¼ ½ ¾ 1 MILE

(MAP IS FROM THE "COASTWALKS" BOOK, c/o THE AMRICAN LITTORAL SOCIETY)

DIRECTIONS FOR BOAT TRIP

Route 36, Highlands, NJ

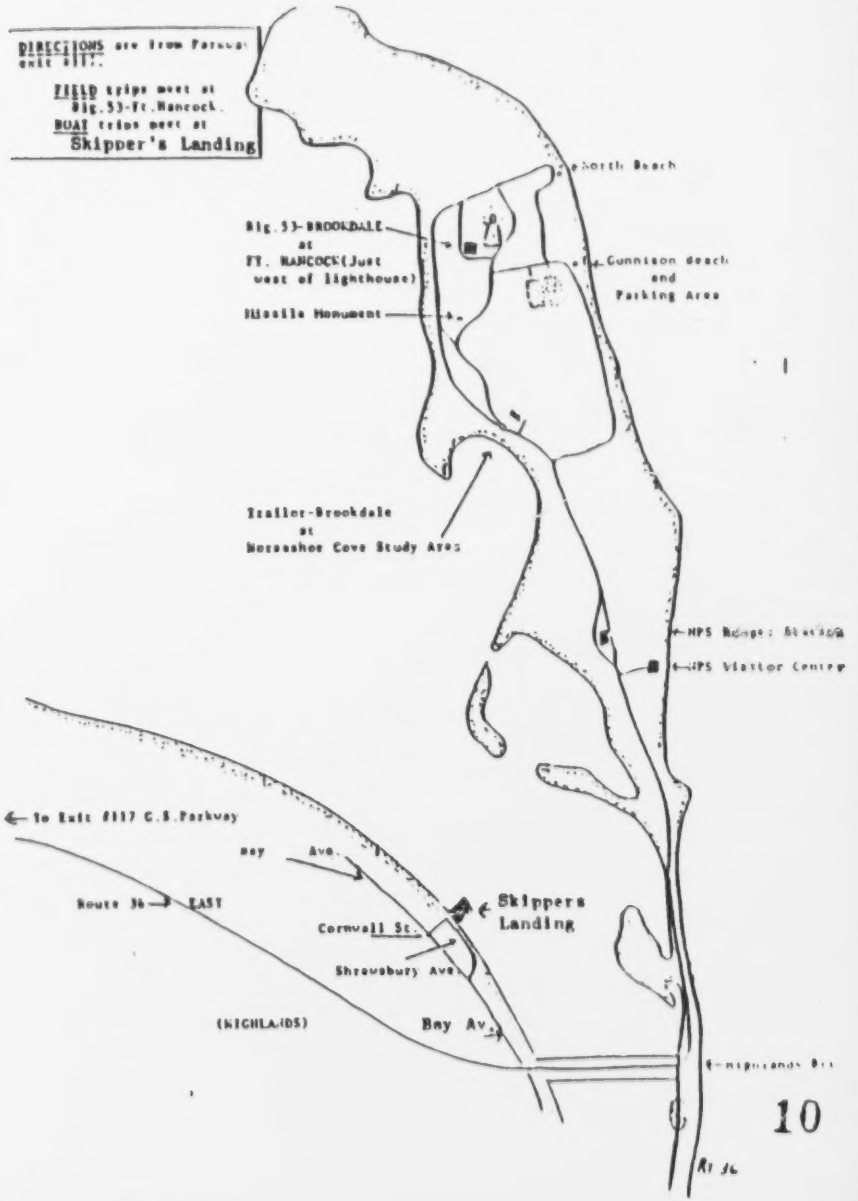
COMING FROM THE NORTH.....

Take Garden State Parkway to Exit 117. Follow signs to Route 36. Before crossing the Highlands Bridge to Sandy Hook, turn right, go down the hill and turn left under the bridge, continue along Bay Avenue to Shrewsbury Avenue (the first street on the right). Turn right onto Shrewsbury Ave. and part at Skippers Landing. The "MS. HIGHLANDS" is docked here.

COMING FROM THE SOUTH.....

VIA Garden State Parkway - Parkway to Exit 109. Follow signs for Route 520, East. Take 520 east to Sea Bright (approx. 6 mi.). Turn left on Route 36. Go up Rt. 36 and cross the Higlands Bridge. Immediately turn right and go down the hill. Turn left and continue on Bay [illegible] as above. The "MS. HIGHLANDS" is docked about 1/3 mi. north of the Highlands Bridge.

New Jersey Turnpike - N.J. Turnpike to Exit 8 at Hightstown. Follow Route 33 to Freehold. Follow signs for Route 537 east. Take Rt. 537 east through Colts Neck to Route 50, Swimming River Rd. (1st left past Due Process Stables). Turn left. Follow Swimming River Rd. to Route 520 (Newman Springs Rd.). Turn right at light. Follow Rt. 520 East to Route 36 in Sea Bright. Turn Left. Proceed as above.



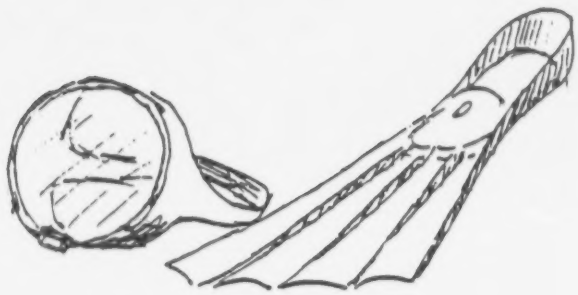
Session 1 - Diving into Marine Science

Diving into Marine Science - Pool session explores human activities in the sea. The physical properties of seawater are explored - sound and light transmission, density, pressure, salinity, temperature. Safety and confidence-building around water will be stressed. (Session is off Sandy Hook at indoor pool. Equipment (mask, fins, snorkel) provided). Location: Dosils Sports Center (Manny's and Mary's Sport Shop) - 261 Hwy 36 East, E. Keansburg. Phone: 787-0508

Materials Needed are: Bathing suit, towels. Lockers and lockerrooms are provided. Bring your own mask, fins and snorkel if available.

Activity: Lecture will be on the Physics of Diving (the gas laws, pressure, sound in the sea, etc.) man's limitations in the sea. Pool activities demonstrate problems and practices in underwater work. Scuba will be demonstrated. Skin-diving (mask, fins and snorkel) will be practiced for Session 2.

Assignment: Do assigned readings and practice in a pool if possible to prepare for Session 2.



DIVING INTO MARINE SCIENCES

History

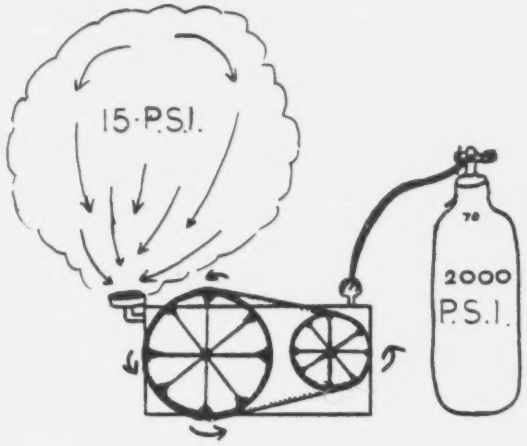
Working under water is not new. Diving into the sea is an ancient occupation, practiced by salvage divers, pearl divers and fishermen. Their equipment was primative - sometimes consisting of only a simple viewing mask and a bathing suit. The famous Ama pearl divers of Japan are considered among the best "skin divers" in the world. Diving from a small boat, they can stay submerged for a minute or more in waters 20 feet deep as they gather pearl oysters - all on one breath of air! Jules Verne dreamed of people underwater, living independent of the surface and moving freely about. Even a hundred years ago, divers with air hoses attached to simple (and sometimes unreliable) surface pumps were able to explore shallow waters and assist in building bridge foundations.

But it was not until after World War II that Jacques Cousteau and others were able to perfect a truly "self contained underwater breathing apparatus" - SCUBA. Scuba allows a diver to bring along an hour's worth of air. Therefore a "scuba diver" is truly self-contained and independent of the surface (at least until the air is used up!)

Physics of Diving

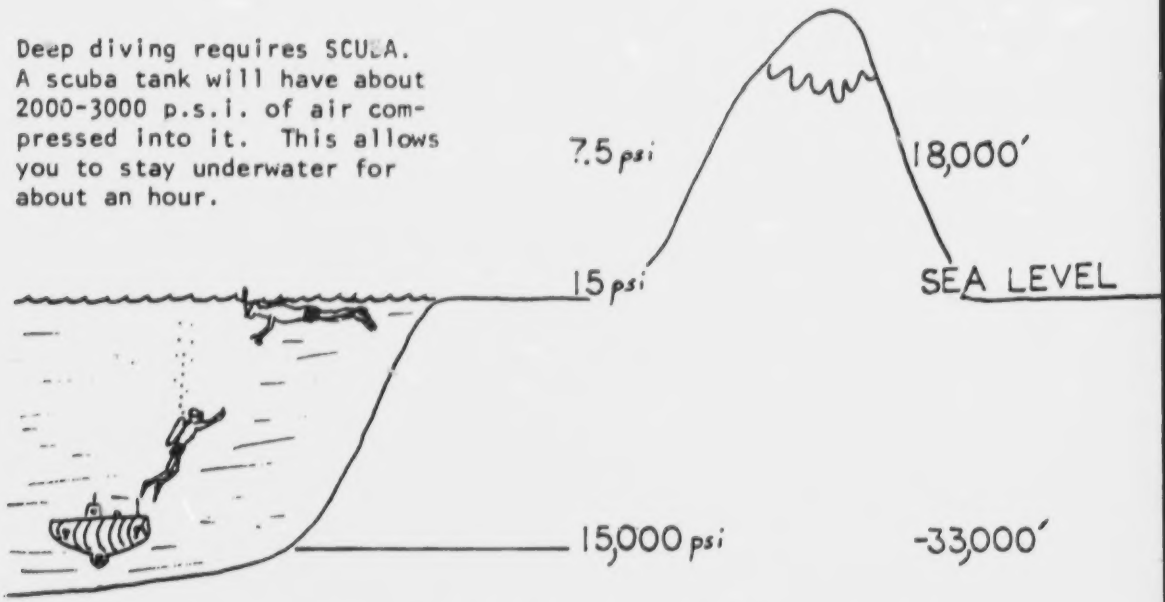
Pressure is the biggest problem to a diver who wishes to stay underwater for more than one breath. The weight of water causes the pressure you feel on your body when you dive deeply. The deeper you go, the greater the pressure becomes.

At sea level, air pressure is about 15 p.s.i. (pounds per square inch). This is referred to as one atmosphere (atm.) - the weight of that air. Since water is more dense than air, only 33 feet of water depth will add another atmosphere of pressure (15 p.s.i.) to your body if you dive down 33 feet deep. The total presure on your body then equals <u>two</u> atmospheres or about 30 pounds per square inch. (No wonder your ears "pop" when you dive to the bottom of a pool!)



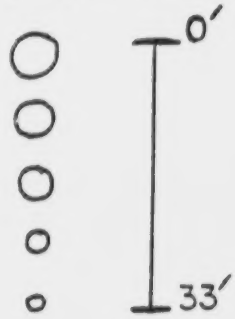
Can you build a snorkel that is 3 feet long and use it to breath through when you go deep? (Think of the movie scene where the hero escapes trouble by hiding in the water and breathing through a hollow reed...) No. The added pressure of the water is too heavy for your lungs to push against. A snorkel only functions in shallow water where the pressure difference is slight.

Deep diving requires SCUBA. A scuba tank will have about 2000-3000 p.s.i. of air compressed into it. This allows you to stay underwater for about an hour.



Scuba works in deep water because the air in the tank (2000 p.s.i.) is much greater than the water pressure at most diving depths (0-150 ft.)

Watch a diver's bubbles. As they are released they will grow larger and larger as they rise to the surface. Why? They expand because the pressure on them decreases as they approach the surface. What is the difference in pressure when a bubble is at 33 feet, then rises to the surface.



Pressure at 33 feet = 2 atm. = 30 p.s.i.
Pressure at 0 feet = 1 atm. = 15 p.s.i.

Answer: 30-15 = 15 p.s.i.

DEPTH	ATM.	P.S.I.

Diving Physiology

The human body can be damaged when compressed air (Scuba) is used or a diver rises too fast or stays down too long. Here are some problems you may have heard about:

Problem	Symptom	Causes
Hypothermia	Uncontrolled shivering, cramps	Rapid heat loss. Low body temperature from diving in cold water. Divers should wear protective suits.
The Bends	Pain in the joints. Itching under the skin	Gas bubbles forming in tissues because a diver did not "decompress". Divers should not stay down too long.
Gas Embolism	Dizziness, headache, shock, paralysis, death	Expanding gas bubbles in arteries block blood circulation to vital organs. Occurs when divers come up too fast.
Nitrogen Narcosis (Rapture of the deep)	Sleepiness, giddiness, confusion, drunken behavior	Diving too deep (100-300 feet) causes nitrogen to build up in tissues, which poisons the nervous system.
Carbon monoxide poisoning	Sleepiness, lung damage, weakness	"Bad" air in the scuba tank. Smoking or being in a smoke filled place before diving. Carbon monoxide is one of many poisons in smoke and it stays in your blood over 8 hours. Divers should not smoke, especially underwater!

Diving is a safe sport as long as all the safety rules are followed.

Safety

Here are some safety tips:

1. Always obey the instructor. (He probably knows more than you do about this!)
2. Always have a partner and stay together at all times.
3. Don't use equipment you're not trained to use.
4. Know your limits. Don't push yourself.
5. Don't walk around while wearing flippers or masks... you might fall and you will also damage the equipment.
6. Don't run or "horse around."
7. If you feel cold, get out and warm up for awhile.(Don't forget Rule #2.)
8. Relax and enjoy the experience. (Remember Rule #4.)
9. Ask questions if you don't understand something. (Remember Rule #1.)

DIVING EQUIPMENT AND ITS USE

EQUIPMENT	USE	ADAPTATION/FUNCTION
Mask, Goggles		
Snorkel		
SCUBA Tank		
Regulator		
Fins		
Wet suit		
Weight belt		
Pressure gauge		
Compass		
Knife		
Depth gauge		
Flotation vest		

Follow up Activities

1. Find stories about diving by people like Jacques Cousteau and Jules Verne, and write a short adventure story of your own.

2. Learn about living and working in the sea. Who built the first submarine? Where was it built? What was its name?

3. Do a report on careers in diving or working underwater.

Write to:

National Association of Underwater Instructors, Cotton, California.
N.O.A.A., Manned Undersea Science and Technology, Rockville, Maryland.
Nautical Archeology Dept., Texas A&M University, College Station, Texas.
Naval Submarine Medical Center, Naval Submarine Base, New London, Connecticut.

Visit:

A local "dive shop"
A Navy recruiter (Don't sign anything while you're there!)

Session 2: Meeting Marinelife

Meeting Marine Life - The underwater environment along Sandy Hook Bay is studied. Collecting by the students (this is wet work!). Goal will be to observe the great variety of habitats available to coastal marine life and the inhabitants found there.

Location: Grant's Cove - Meet at "Topic" headquarters - Sandy Hook.

Materials: Mask, fins and snorkels; bathing suit, towels, sweatshirt, snacks.

Activity: Collecting marine life, and observing the behavior of creatures in their element.

Assignment: Write a "Diver's Log" of your observations underwater (time, location, tide, water temperature, etc.).

A DAY IN THE BAY

To make certain your diving experience is safe and enjoyable, several hints are provided. Please read this carefully and ask the instructor if you any questions.

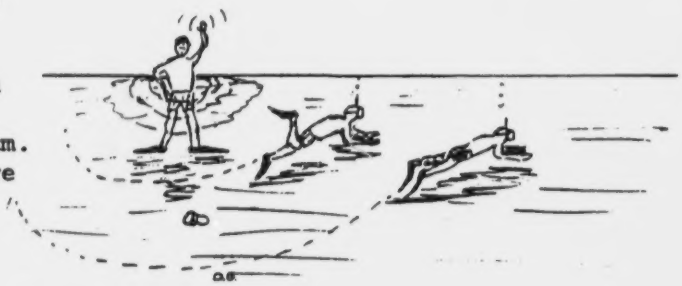
Safety

These rules must be followed at all times:

1 - Never enter the water alone. Stay with your partner.
2 - Stay within the area indicated as the diving zone. Don't stray into other areas or climb on the rocks and pilings.
3 - Wear something on your feet at all times. Flippers or sneakers are a must.
4 - Keep warm. Only stay in the water 15 minutes at a time. This will conserve body heat and energy. It also gives others a chance to share equipment.
5 - Don't "horse around." It stirs up the water, scares away fishes we want to observe, and attracts sharks.

Lost Equipment

Always make sure your equipment fits snuggly. If a piece is lost, immediately stop where you are. Notify the instructor and other divers. Organize a search pattern as illustrated, but don't move until the others find the lost item. It should be close to where you are standing.



MEETING MARINELIFE

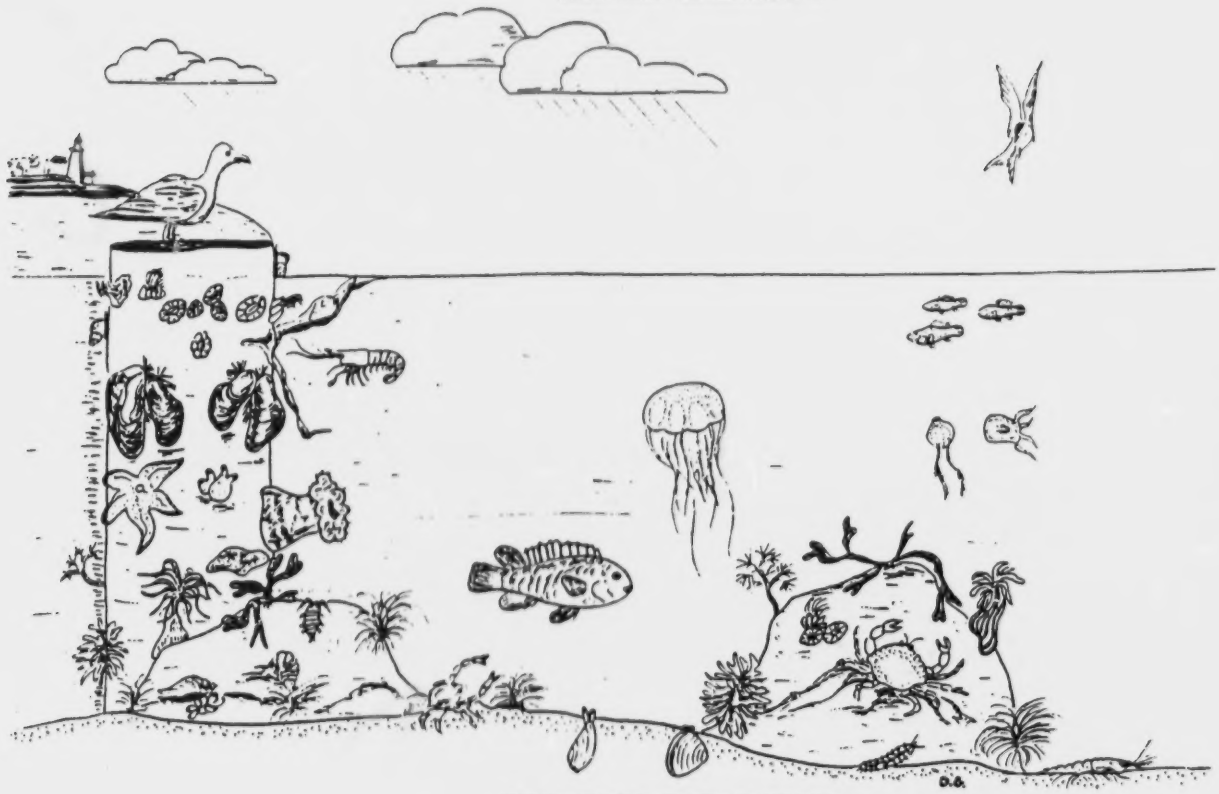
The best way to observe marinelife is to stay relaxed, but alert and avoid any sudden movements that will startle the animals you seek. By moving slowly or sitting quietly, you will not threaten those creatures that are always on the lookout for predators.

Studying animal behavior is fascinating, but you must be patient. Fishes will concentrate near rocks or pilings where they find food and shelter. Rock crabs prefer hiding in crevices during the day and swimming crabs bury themselves in the sand. Grass shrimp hover around pilings and sand shrimp blend with the bottom, but they're always around if you look carefully.

Any rocky or hard place will become a reef for dozens of creatures that can't live in the soft, muddy bottoms. Mussels, barnacles and anemones are most common. Approach them carefully and you can watch them filter plankton from the water.

Don't forget the muddy bottoms. If you're careful and don't stir up the fine silt and detritus, you'll see worm tubes and the trails of other animals that feed there.

MEETING MARINELIFE



UNDERWATER OBSERVATIONS

Site	Animal	Behavior/Observations

Water Temp._____ Air Temp._____ Weather_____ Water Visibility_____

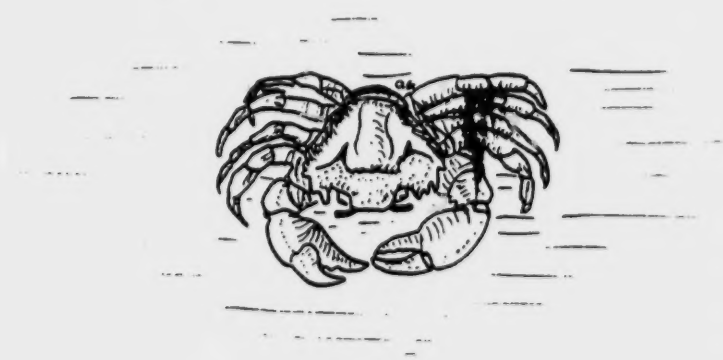
MENACING MARINELIFE

There are many potentially dangerous animals in the sea and if divers are not careful, injuries are possible. Most injuries to divers occur when common, or harmless animals are mishandled. Spines, fins, or sharp edges that are an animals adaptations to life underwater can accidently puncture the skin.

Caution and protective gear, especially flippers or sneakers are your best defense against possible injury. Remember, most injuries are the result of carelessness, so watch where you sit!

Some Hazardous Animals

Animal	Hazard	Size	Range/Location
Barnacles	Sharp edges, tears	1/2"	N.J.-rocks,pilings, etc.
Sea Urchins	Spines, punctures	1-5"	N.J.-rocks, crevices
Cone Shells	Venom	½-3"	Tropics-Reefs
Lionfishes	Venom	12"	Tropics-Reefs
Stingrays	Venom, lacerations	6'	Tropics-soft bottoms
Jellyfishes	Venom	30'+	N.J.-Plankton
Fire Coral	Venom	6"	Tropics-Reefs
Barracudas	Bites	6'	Tropics-Reefs
Moray Eels	Bites	6'	Tropics-Crevices
Electric Ray	Shock	6'	Tropics-soft bottoms
Sharks	Bites	25'	Worldwide-Anywhere
Sea Snakes	Venom	4'	Tropics-Surface waters



FOLLOWUP ACTIVITIES

1. Write the "biography" of a creature you observed underwater. Try to think and feel like that animal as you write your story.

2. Report on a dangerous or beneficial sea creature. Why it is important... What it does... Where it lives...

3. What is our future in the sea? Learn about underwater habitats and future cities in the sea. Are they possible? How would we build them to work and live there.

Sources

Naval Engineering Laboratory, 1970. Survey of the Navy's Potential Utilization of Manned Underwater Laboratories. Port Hueneme, CA.

Wicklund, R., ed. 1972-73. Hydro-Lab Journal. Riviera Beach, FL Perry Foundation, Inc.

Parrish, B.,1972. Submersibles and Underwater Habitats: A Review. Underwater Journal Information Bulletin, August: p. 149-167.

Session 3 - Marshes:

Marshes - The Most Productive Places in the World - By studying nutrient cycling and physical parameters, and surveying population densities, the students will learn why these coastal areas are so valuable.

Location: Horseshoe Cove, Sandy Hook. Meet instructor at "Topic" Headquarters.

Materials: Provided are: Field Guide Sheets of representative organisms typical of this area; a fact sheet on important characteristics of Marshes.

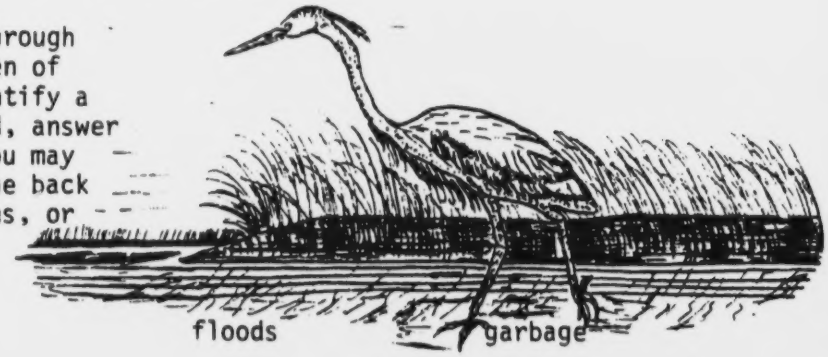
Bring boots or old sneakers for wading, hand shovels and ziplock bags are recommended if available.

Activity: A transect of the marsh will be made. Population density and species composition will be emphasized. Estimates of productivity will be made.

Assignment: An inventory of the types of creatures found, locations, and a description of the marsh we visit.

HOW HARSH IS THE MARSH?

Take a few minutes and read through the following words. Check ten of those that you think best identify a marsh. Once you have finished, answer the questions that follow. You may use your vocabulary list in the back of the book to find definitions, or skip words you don't know.



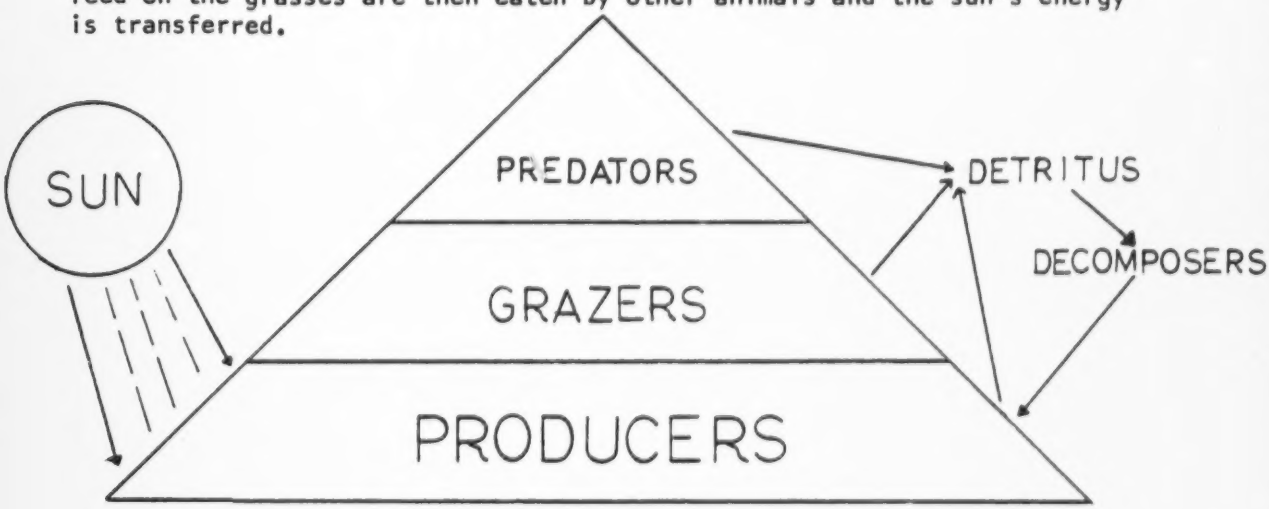
water	food	floods	garbage
land	crabs	friendly	flat
tide	filter	beautiful	important
ebb	hydrogen - H	fun	flies
flow	fishes	nitrogen - N	clams
resource	spartina	nursery	production
salty	rotten	hostile	element
mud	education	grass	mussels
sea	eggs	wind	estuary
air	sulfur - S	resource	odor
sunlight	dry	seaweed	photosynthesis
plants	carbon - C	acre	life
nutrients	birds	phosphorous - P	fishing
sand	recreation	creek	wood
detritus	oxygen - O	currents	people
decay	worms	mosquito	scientific
pollutant	plankton	wastes	awful
pollution	ugly	calm	wild
storms	turtles	fresh	gentle
organic	energy	inorganic	erosion

WHAT IS A MARSH? WHY IS IT IMPORTANT?

A marsh can be different things to different people. Some people like marshes because they think they are pretty. Scientists study marshes because many valuable plants and animals are found there. Fishermen and hunters stalk game in marshes because many fishes and birds feed there. Farmers even harvest grass from marshes to feed cattle. Marshes can be valuable land because so many people like to live near the water. Some people think marshes are bad because they smell and mosquitoes breed in them. What is a marsh and why is it important?

A MARSH IS... a low, wet, grassy area that is frequently covered by water. There are fresh-water marshes, but the most important ones are salt-water marshes that are washed by the tides... TIDAL MARSHES. When the tide rises - or floods - fishes, crabs and other creatures enter the marsh and search for food. As the tide recedes - or ebbs - these creatures move back to the creeks that meander through the marsh. The tidal currents

A MARSH IS... a food factory. The spartina grasses that grow there produce ten tons of nutrients (leaves, stems) per acre. This is seven times more than a corn field produces. The sun gives the grasses the energy they need for photosynthesis to produce more leaves and stems. Animals that feed on the grasses are then eaten by other animals and the sun's energy is transferred.



A marsh might have over 40 million fishes, snails, clams, crabs, insects and other creatures living on each acre. Most of the fishes along our coast (70%) rely on marshes for feeding, spawning and growing.

A MARSH IS... a nutrient "bank". Nutrients and elements like nitrogen, phosphorous, sulfur and carbon are stored and used there. They are trapped in the detritus of the marsh (dead plants and animals and their wastes).

A MARSH IS... a sponge for flood waters. Its low, flat surface holds water during storms and releases it slowly afterward. Marshes protect the land during storms.

A MARSH IS... nature's sewage treatment plant. An acre of marsh can purify the wastewater from several homes (20 people).

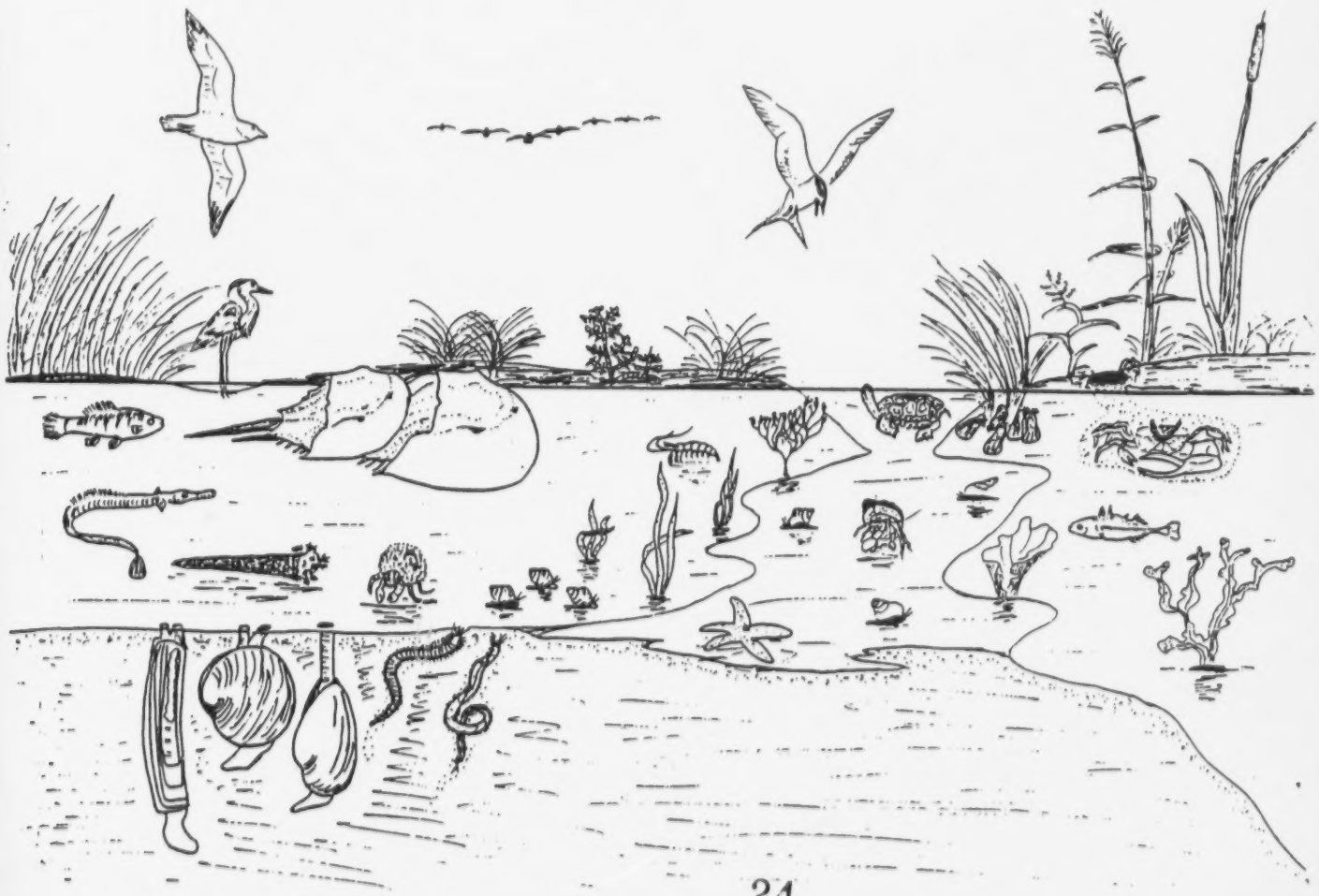
A MARSH IS... delicate. Its soft muds are easily disturbed by human activities. This can kill the sensitive plants and animals that live there.

A MARSH IS... fascinating. Scientist study marshes because they are unique, full of many creatures, and more valuable (productive) than all other areas. Marshes smell because they are full of life.

A MARSH IS... fun. Sportsmen fish and hunt around rich marsh areas. Bird watchers find fascinating and abundant wild life there. Artists find beauty there.

What else is a marsh?_____

_____



FOLLOW UP ACTIVITIES

After visiting and studying the marsh, choose one of the activities to work on at home. This will remind you of your trip to this special place.

1. a - An acre is equal to approximately 40,000* square feet. Calculate the number of fishes, crabs, shrimp, snails and clams that might be found in 10 acres of marsh.

   b - Calculate the number of animals for each square foot of marsh.

   c - Calculate the number of animals for each square inch of marsh.

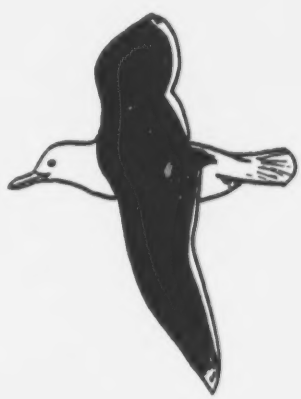
   d - Calculate how many acres of marsh would be needed to purify the wastewater of a town of 20,000 people.

2. Think about the marsh you have just visited and the creatures you saw there. Write a poem about a creature you studied. Imagine yourself as that creature.

   Here's an example:

Choose a word to describe yourself.	BIRD
Write two words that describe your appearance	BOLD, GRAY
Next write three words that describe how you live or where you live	GLIDING, DIVING, CHASING
Then, two words describing your function in the environment	SCAVENGER, PREDATOR
Finally, what you are	SEAGULL

*Exact figure is 43,560 square feet



Session 4 - Boat Trip

Down to the Sea in Ships - An onboard experience to collect and study deeper-water creatures, pollution, human impacts of the sea. Activities will be limited to protected Sandy Hook Bay waters. A U.S. Coast Guard-approved vessel and crew will be used exclusively.

Location - See enclosed map - meet at the boat dock.

Materials - Bring clothing and materials listed on "Boat Trip Fact Sheet" Collecting equipment, maps, etc. will be provided.

Activity - Several stations will be sampled in Sandy Hook. Geological and biological specimens will be taken for anyalysis.

Assignment - Data should be recorded and presented with a description of each station.

SAILORS' SUPERSTITIONS

In the days of wooden ships, sailors had many beliefs to explain both good and bad luck. It was important to respect these superstitions or one sailor might, by his actions, jeopardize the whole ship. A "jonah" was someone who was responsible for the bad luck on a ship. If the crew discovered that a jonah was aboard, he would quickly be set adrift in a small boat with some water and provisions. The crew felt this precaution was necessary to protect the safety of the ship.

Here are some omens that would surely bring bad luck if they weren't heeded. A ship will have trouble aboard...

-if someone hammers nails on Sunday.
-if someone spills paint on the deck.
-if a large bird lands on the ship.
-if a mirror is broken before sailing.
-if the anchor line becomes so tangled that it has to be straightened out before it can be used.
-if you set sail on a Friday.
-if a passenger brings aboard any unusual luggage.
-if women or clergymen are passengers.
-if any crewman can swim.

Can you think of some ways that these superstitions could have evolved? Do you think that there could be any truth to any of them?

Here are some other strange beliefs about the sea...

Mermaids - Some sailors feared that if any crewman saw a mermaid the ship would be lost with all hands.

Sharks - If a shark follows a ship, a passenger or crew will soon die.

Clergy - Since the devil hates clergymen and he will do anything to harm them, a ship that carries one is in certain danger.

Porpoises - If a sailor kills a porpoise, even by accident, he will have bad luck for the rest of his life.

Birds - If a Storm Petrel lands on the ship, a storm will soon begin. If a Storm Petrel or Albatross is killed by a sailor, it will bring bad luck to the ship.

There were good omens and beliefs too. Here are a few...

-If a small bird or bee lands on the ship before it sails, the voyage will be safe and prosperous.

-Tatoos on a sailor are considered good luck charms and help insure a safe voyage.

-Porpoises are a sailor's best friend. They will guide ships out of danger, protect sailors from sharks and rescue drowning victims by pushing them ashore.

-If a sailor dies at sea, his spirit remains with the ship and his shipmates. He can reappear at times to warn his crewmates of impending dangers.

MORE SEA STORIES

Discipline is very important on a ship, especially on long voyages. Keel-hauling was the punishment for mutineers in the 1700's and early 1800's, and was usually fatal. A mutineer was dragged under the hull and oftentimes bled to death from the cuts be received from the barnacles growing on the keel.

Whistling on sailing ships was not permitted because it could be confused with the captain's orders that were given by the boatswain on his "bosun's" whistle. Its shrill sound could be heard even when a strong gale was blowing and the ship was creaking and straining. However, when the ship was becalmed, everyone was expected to whistle. Hopefully this would get the attention of St. Anthony, who would send fair sailing winds.

Early sailors made animal sacrifices to the gods to ask for protection from all the dangers of the sea. Today that tradition still survives. Modern boat builders "sacrifice" a bottle of the finest spirits by smashing it across the bow of a ship at launching. This is done to insure good luck.

So you see, even today we're a little superstitious when it comes to ships and sailing the wide oceans. Some interesting reading about ships and superstitions:

The Rhyme of The Ancient Mariner

The Flying Dutchman

The Bermuda Triangle (by Charles Berlitz)

Sailing Alone Around The World (by Joshua Slocum)

The Book of The Sea (by A. C. Spectorsky)

The Mystery of The Mary Celeste

WORK ASSIGNMENTS

	LEADER	CREW MEMBERS
Team A		
Team B		
Team C		
Team D		
Team E		
Team F		

Task	Temp.	Salinity	pH	D.O.	Depth	Bottom
Site 1	A	B	C	D	E	F
Site 2	B	C	D	E	F	A
Site 3	C	D	E	F	A	B
Site 4	D	E	F	A	B	C
Site 5	E	F	A	B	C	D

BOAT TRIP DATA SHEET

Vessel_____ Length_____ Port_____

Date_____ Sailing Time_____ Return Time_____

METEOROLOGICAL DATA

Wind: Direction_____ Speed_____ Time_____ Elevation_____

Air Temperature_____ Barometer_____

Clouds: Type_____ Percent Cover_____

Description of Weather_____

_____

SEA SURFACE CONDITIONS

Sea State_____ Swell: Height_____ Period_____

Stage of Tide_____ Predicted High Tide_____

Surface Current: Velocity_____ Direction_____

WATER SAMPLING DATA

Site 1 Surface: Temp._____	Salinity_____	pH_____	D.O._____
Site 1 Bottom: Temp._____	Salinity_____	pH_____	D.O._____
Site 2 Surface: Temp._____	Salinity_____	pH_____	D.O._____
Site 2 Bottom: Temp._____	Salinity_____	pH_____	D.O._____
Site 3 Surface: Temp._____	Salinity_____	pH_____	D.O._____
Site 3 Bottom: Temp._____	Salinity_____	pH_____	D.O._____
Site 4 Surface: Temp._____	Salinity_____	pH_____	D.O._____
Site 4 Bottom: Temp._____	Salinity_____	pH_____	D.O._____
Site 5 Surface: Temp._____	Salinity_____	pH_____	D.O._____
Site 5 Bottom: Temp._____	Salinity_____	pH_____	D.O._____

BOTTOM SAMPLING

Site 1 Bottom Type: Rock/Gravel/Sand/Mud
Depth_____ Organisms_____

Site 2 Bottom Type: Rock/Gravel/Sand/Mud
Depth_____ Organisms_____

Site 3 Bottom Type: Rock/Gravel/Sand/Mud
Depth_____ Organisms_____

Site 4 Bottom Type: Rock/Gravel/Sand/Mud
Depth_____ Organisms_____

Site 5 Bottom Type: Rock/Gravel/Sand/Mud
Depth_____ Organisms_____

BOAT TRIP RECORDING SHEET

SITE____
SURFACE
Temp___
Sal ___
pH ___
D.O.___

SITE____
SURFACE
Temp___
Sal ___
pH ___
D.O.___

SITE____
SURFACE
Temp___
Sal ___
pH ___
D.O.___

SITE____
SURFACE
Temp___
Sal ___
pH ___
D.O.___

10'

20'

SITE____
DEPTH____
Temp___
Sal ___
pH ___
D.O.___

SITE____
DEPTH____
Temp___
Sal ___
pH ___
D.O.___

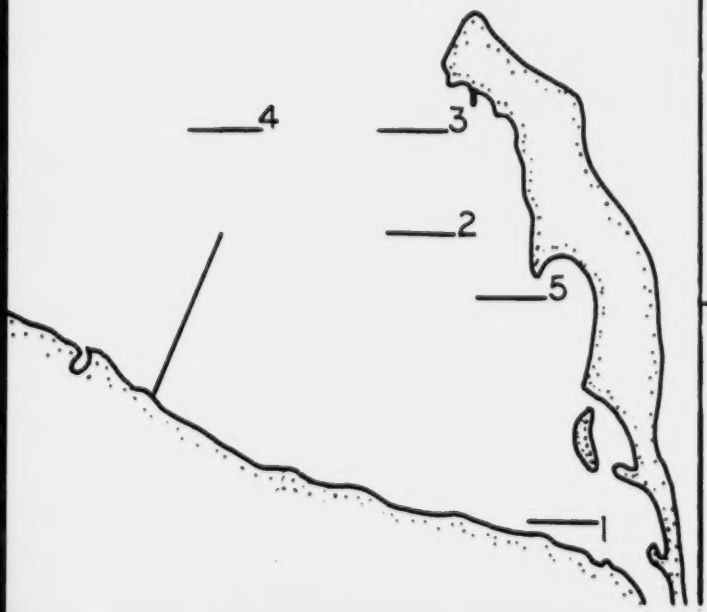
SITE____
DEPTH____
Temp___
Sal ___
pH ___
D.O.___

SITE____
DEPTH____
Temp___
Sal ___
pH ___
D.O.___

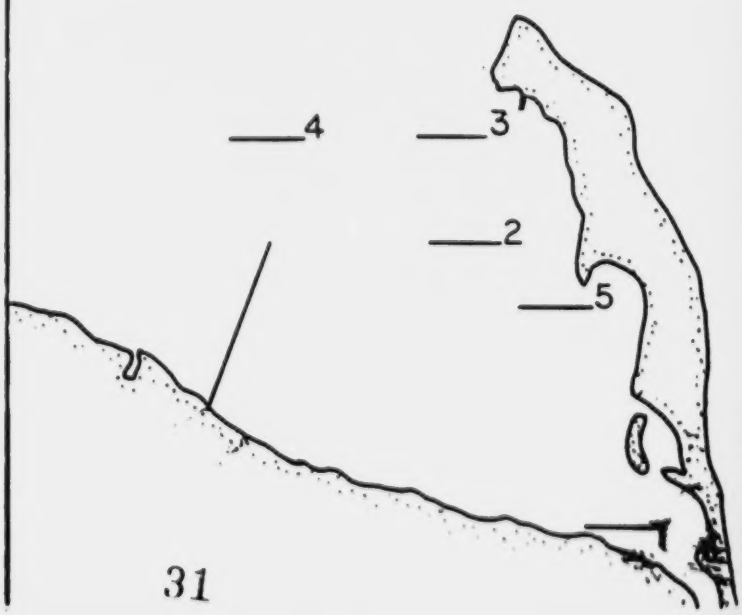
30'

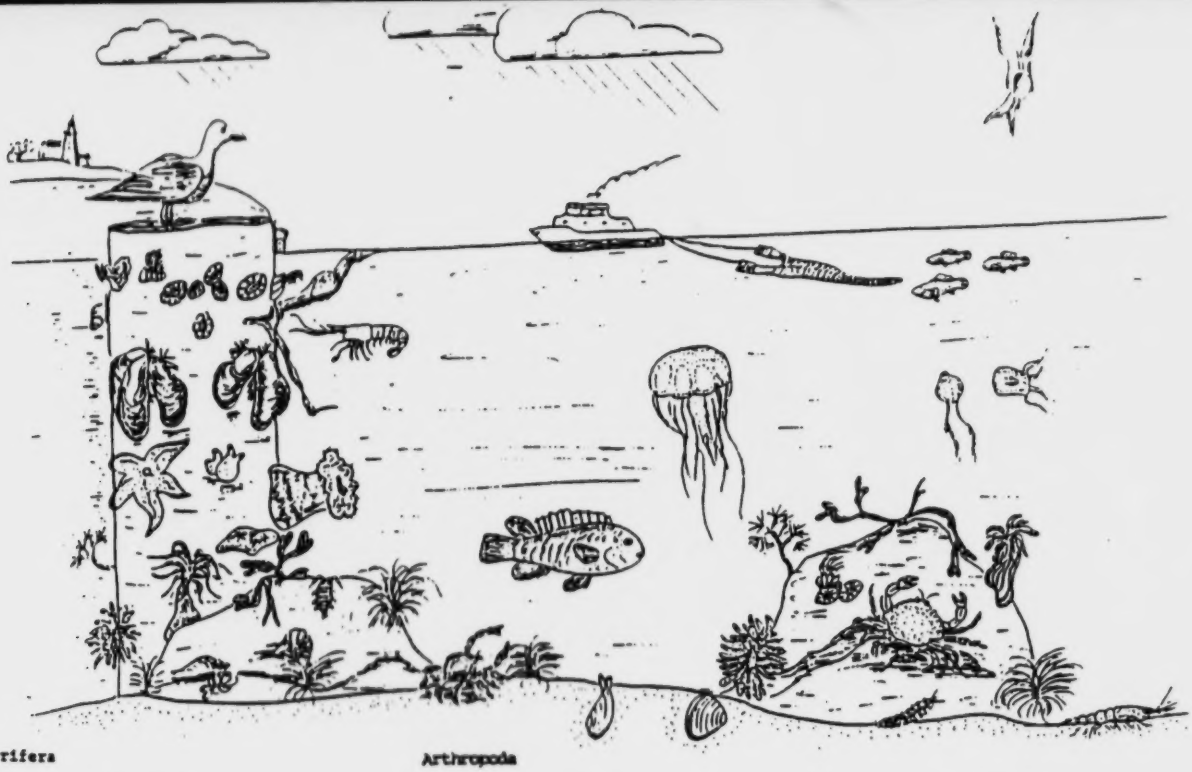
Bottom_____ Bottom_____ Bottom_____ Bottom_____

SURFACE TEMPERATURES



SURFACE SALINITIES





Porifera

___ 1. Sulfur Sponge
___ 2. Red Beard Sponge

Coelenterata

___ 3. Snail Fur
___ 4. Sea Nettle
___ 5. Lion's Mane
___ 6. Sea Anemone
___ 7. Star Coral

Ctenophora

___ 8. Sea Gooseberries
___ 9. Slipper Comb Jelly

Bryozoa

___ 10. Bugula
___ 11. Sea Mat

Molluscs

___ 12. Hard Clam
___ 13. Soft Clam
___ 14. Oyster
___ 15. Blue Mussel
___ 16. Ribbed Mussel
___ 17. Oyster Drill
___ 18. Moon Snail
___ 19. Mud Snail
___ 20. Periwinkle
___ 21. Common Slipper Shell
___ 22. Flat Slipper Shell
___ 23. Basket Snail

Annelida

___ 24. Blood Worm
___ 25. Sand Worm
___ 26. Bristle Worm

Arthropoda

___ 27. Rock Crab
___ 28. Calico Crab
___ 29. Spider Crab
___ 30. Hermit Crab
___ 31. Mud Crab
___ 32. Blue Crab
___ 33. Sand Shrimp
___ 34. Grass Shrimp
___ 35. Skeleton Shrimp
___ 36. Scud
___ 37. Lobster
___ 38. Horseshoe Crab
___ 39. Barnacle

Echinodermata

___ 40. Starfish

Urochordata

___ 41. Sea Squirt

Chordata

___ 42. Fluke
___ 43. Flounder
___ 44. Window Pane
___ 45. Cunner
___ 46. Blackfish
___ 47. Bluefish
___ 48. Porgy
___ 49. Spot
___ 50. Silverside
___ 51. Anchovy
___ 52. Ling
___ 53. Whiting
___ 54. Puffer
___ 55. Sea Bass
___ 56. Weakfish
___ 57. Herring
___ 58. Menhaden
___ 59. Toadfish
___ 60. Sea Robin
___ 61. Sea Horse
___ 62. Eel
___ 63. Dogfish

Birds

___ 63. Herring Gull
___ 64. Black-backed Gull
___ 65. Laughing Gull
___ 66. Cormorant

Plants

___ 67. Sea Lettuce
___ 68. Pop Weed
___ 69. Red Rock Weed
___ 70. Eelgrass

ADDITIONAL SPECIMENS

Session 5 - Botany

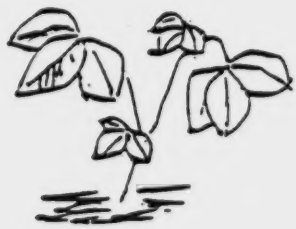
Barrier Beach Botany - An ecological view of the beach using the distinctive vegetation found here. Plant and animal adaptations to environmental stress will be observed.

Location - Meet at "Topic" Headquarters - Sandy Hook.

Materials - Two activities are planned: A plant identification walk along the hook and a visit to the holly forest.

Activity - A transect will be made from bay to beach emphasizing plant zonation, soils, stress, etc.

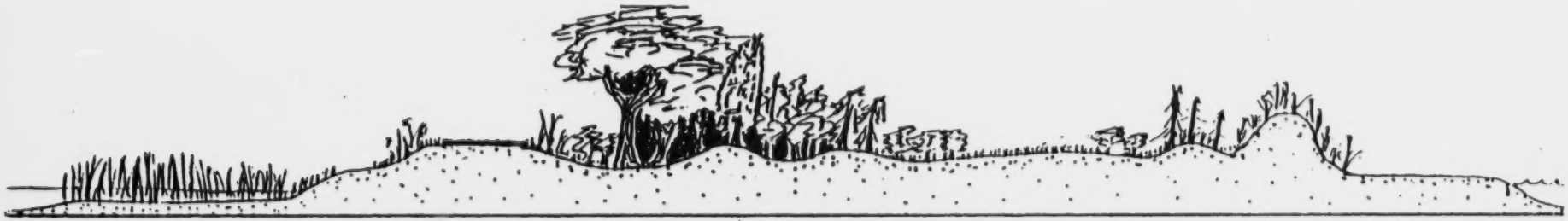
Assignment - Catalogue species composition for the zones studied. Write a description of each zone.



Plantlife at the Shore

Check off plants as they are identified. Classify each Zone of Vegetation by rating its water/soil/light
(0)-None, (+)-Little, (++)-Moderate, (+++)-Much

MARSH	FIELDS/ROADSIDES	HOLLY FOREST	THICKETS	POVERTY GRASS	DUNES
Water____	Water____	Water____	Water____	Water____	Water____
Soil____	Soil____	Soil____	Soil____	Soil____	Soil____
Light____	Light____	Light____	Light____	Light____	Light



MARSH	FIELDS/ROADSIDES	HOLLY FOREST	THICKETS	POVERTY GRASS	DUNES
___Cord Grass	___Cactus	___Holly	___Holly	___Beach Heath	___Dune Grass
___Salt Hay	___Poison Ivy	___Poison Ivy	___Poison Ivy	___Toad flax	___Seaside Goldenrod
___Pickleweed	___Switch Grass	___Green Briar	___Green Briar	___Wormwood	___Beach Pea
___Marsh Elder	___Red Cedar	___Red Cedar	___Red Cedar	___Cactus	___Sea Rocket
___Sea Lavender	___Broom Grass	___Virginia Creeper	___Virginia Creeper	___Bayberry	___Cocklebur
	___Chicory	___Solomon's Seal	___Solomon's Seal	___Earth Stars	___Seaside Spurge
	___Ox-eye Daisy		___Beach Plum	___Pinweed	
	___Rabbit Foot Clover		___Shad Bush	___British Soldiers	
	___Sweet Clover		___Blueberry		
	___Plaintain		___Hackberry		
	___Mullein		___Bayberry		
	___Dandelion		___Sumac		
	___Queen Anne's Lace		___Cherry		
	___Soapwort		___Pearly Everlasting		
	___Bladder Campion		___Rose		
	___Milkweed		___Groundsel Tree		

Quiz Botany

1. What is the most valuable plant on Sandy Hook?_____

2. What is the most productive plant on Sandy Hook?_____

3. What is the "climax forest" tree on Sandy Hook?_____

4/5. Name two nice things about poison ivy._____, _____

6. Why are the trees at Sandy Hook mostly "fruit trees", not nut trees?

_____

7. The process by which one group of plants forces out another is called

_____.

8/9/10. What three things are necessary for plants to grow?_____,

_____, _____.

Follow-up Suggestions

1. Make a plant list of your backyard, neighborhood, or school yards and compare it to the plant list from Sandy Hook.

   Are any of the same plants found in both places? Explain your results.

2. What is the world's tallest plant?
   ...the largest?
   ...the fastest growing?
   ...the oldest?

3. "Grasses thrive at the beach and marsh because few other plants can survive there." Prove that statement using information you received on your field trip.

Can you list any other grasslands around the world? Why do grasses dominate in these places?

4. Make a list of ten plants that are used for: medicine, food, fuel, decoration, clothing, farm animals, seasoning, rope, protection, building.

Session 6 - Water and Waves

Water and Waves - The physical and geological features of the shore. The generation of waves and currents and their effect on the coast.

Location - Meet at "Topic" Headquarters - Sandy Hook.

Materials - Articles provided are on waves and wave damage.

Activity - Wave watching and measurement of longshore transport mechanisms. Coastal structures and their effects on beaches.

Assignment - Evaluate wave conditions during visit. Calculate wave speed, period and size, and current flow.

Making Waves

The surface of the ocean is always in motion. Even on the calmest of days you will notice small waves surging against the shore. There are different types of waves. Let's study what waves are, how they form and how we can measure them.

What Is A Wave?

Can you describe a wave? Think of several words that define a wave.

_____, _____, _____, _____, _____

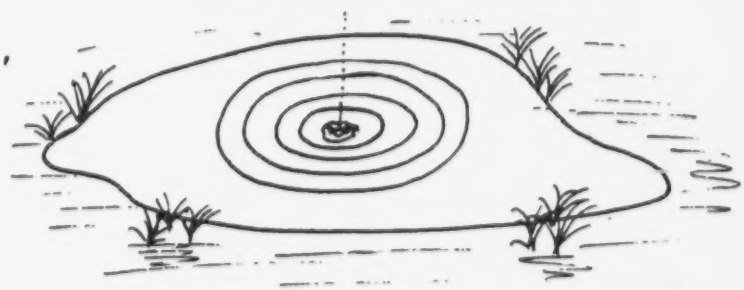
A dictionary definition would be: "...the alternate rising and falling of the surface of the water...". Look at the words you wrote down to describe a wave. Can you think of a better definition?

_____

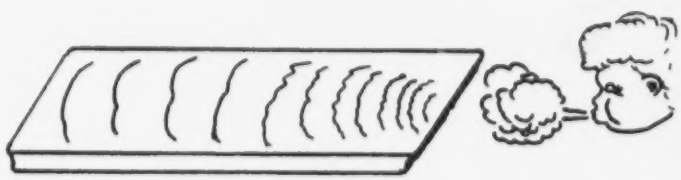
_____

_____

If you drop a stone into a puddle, waves will form and spread out in all directions. If you blow air across the surface of a pan of water, waves will also form and spread out in the direction that the air is moving



In both cases you are adding ENERGY to the water and this is what creates waves. The energy moves through the water in the form that we recognize as a wave. Therefore, what is a wave?



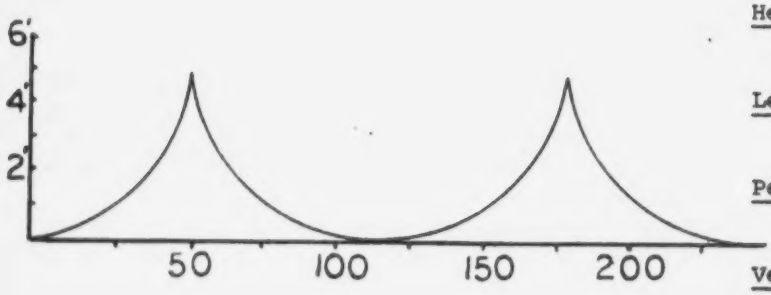
_____

_____

_____

Measuring Waves

Now that we have a definition of a wave, let's look at a wave and its characteristics.



A wave is described by its:

Height - the vertical distance from the crest to the trough.

Length - the horizontal distance between two crests

Period - the time it takes for two waves to pass a stationary point.

Velocity - the speed that a wave travels.

These characteristics determine how much your boat rocks, as well as how much force the waves have.

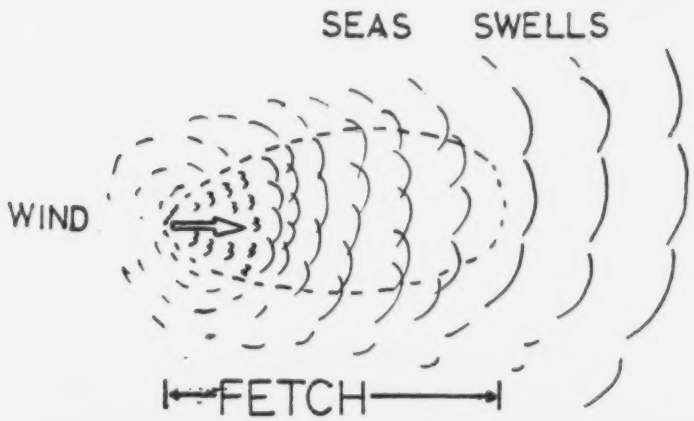
- Questions -

1. What is the Height of these waves?_____
2. What is the Length of these waves?_____
3. If it takes five seconds for two waves to pass under your boat, what is the Period of these waves?_____
4. What is the Velocity of these waves?_____

Wind Waves

Wind waves are the most common types of waves in the sea. On a stormy day it is easy to see waves forming from the force of the wind. The size of the waves depends on three factors:

Velocity - The stronger the wind blows, the larger the waves will become.
Duration - The longer the wind blows, the larger the waves will become.
Fetch - The distance that the wind blows across the water will affect how much energy can be transferred to the water's surface. The greater the distance (fetch) the larger the waves will become.



Surf, Seas and Swells

Waves can be classified according to their shape. In a storm, where wind waves are forming, sailors will sometimes describe the surface as "SEAS". Choppy and irregular waves are sometimes called seas.

The length of these waves varies between 12 to 35 times their height. (What is the wave length of ten-foot storm waves?_____ feet to about _____ feet.)

As wind waves move away from the stormy area they flatten out and their crests become more rounded. Their length increases though, and it is now 35 to 200 times their height. These smooth waves are called "SWELLS". Their length is between 35 to 200 times their height. (What is the wavelength of five-foot swells? _____feet to about_____feet.)

Eventually swells will reach some coastline. As they move into shallower water they again begin to change form because of friction against the bottom.

As the waves slow down, they begin to bunch up again (wavelength decreases) and their height increases. Where the wave reaches water that is shallower than 1.3 times the wave height the wave will become unstable and collapse. We refer to these breaking waves as SURF.

Can You unscramble these captions???

SAILOR_____ FISHERMAN_____ SURFER_____

SWELL SUMMARY SHEET

Wind Waves - The HEIGHT and LENGTH of waves is determined by FETCH, WIND, VELOCITY and the length of TIME that the wind blows.

Their LENGTH is about 12 to 35 times their HEIGHT.

They are PROGRESSIVE. That is they move in one direction like the wind that forms them.

Whitecaps occur in wind velocities of 12 knots or more.

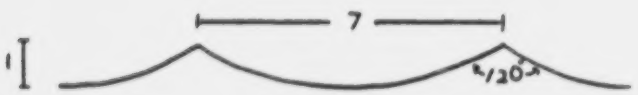
Swells - Swells have rounded crests and LENGTHS about 35 to 200 times their HEIGHT.

Swells drag on the bottom when water depth is half the WAVELENGTH.

Swells lose one third of their height each time they travel a distance in miles equal to their length in feet.

Surf - Waves break when the ratio of HEIGHT to LENGTH equals 1: 7 or less.

Waves break if the angle of their crest is 120° or less.

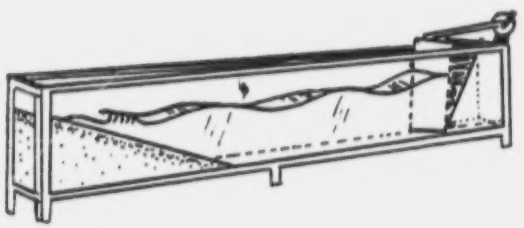


Waves break if they move into water that is 1.3 times the wave HEIGHT.

$$D = 1.3\ (H)$$

RELATIONSHIPS - Wave Velocity, Length and Period are related. By knowing one value, you can approximate the other.

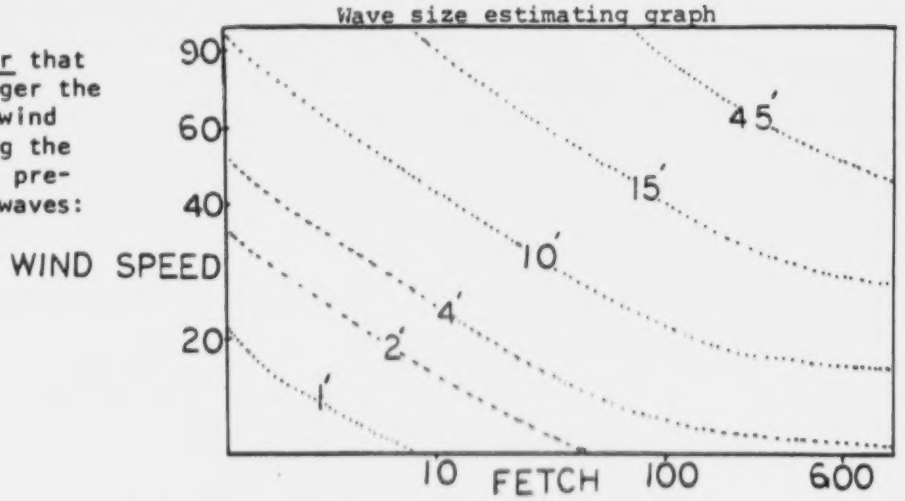
$$\text{Velocity} = 3\ (\text{Period})$$
$$\text{Length} = 5\ (\text{Period})^2$$
$$\text{Period} = 1/3\ \text{Velocity}$$



How Does A Wave Behave?

Waves behave predictably. Using wavetanks and observations at sea, it is possible to make a list of rules that determine wave behavior.

WAVE SIZE - The stronger that the wind is and the longer the fetch is, the bigger a wind wave will become. Using the wave-forecasting chart, predict the size of these waves:



1. Waves in a thunder storm with 20 knot winds and a 10 mile fetch could be_____feet high.

2. Waves in a storm with 40 knot winds and a 100 mile fetch could be_____ feet high.

3. Waves in a hurricane with 64 knot winds and a 600 mile fetch could be _____feet high.

WAVE LENGTH - The distance between waves can be estimated if you know the wave PERIOD. Remember a relationship exists between the LENGTH, PERIOD, and VELOCITY of waves.

$$\text{LENGTH} = 5\ (\text{Period})^2$$
$$\text{LENGTH} = 5\ (\text{Period} \times \text{Period})$$

1. What is the LENGTH of a five second wave? 5 (____x____) = _____ feet.

2. What is the LENGTH of a six second wave? 5 (____x____) = _____ feet.

3. What is the LENGTH of a ten second wave? 5 (____x____) = _____ feet.

WAVE VELOCITY - Wave speed varies with WAVE LENGTH. Wave speed can be estimated using an equation, but you must first know the PERIOD of the wave.

VELOCITY = 3 (Period)

1. What is the VELOCITY of a wave with a period of five seconds?

   3 (5) = _____ knots

2. What is the VELOCITY of a wave with a period of six seconds?

   3 (6) = _____ knots

3. What is the VELOCITY of a wave with a period of ten seconds?

   3 (10) = _____ knots

Waves will change speed as they approach the beach. As a wave enters shallow water it will begin to drag on the bottom if the depth of the water is less than one half the WAVELENGTH. When this happens the wave slows down. Because it is slowing down, the waves following it catch up and the WAVELENGTH is shortened.

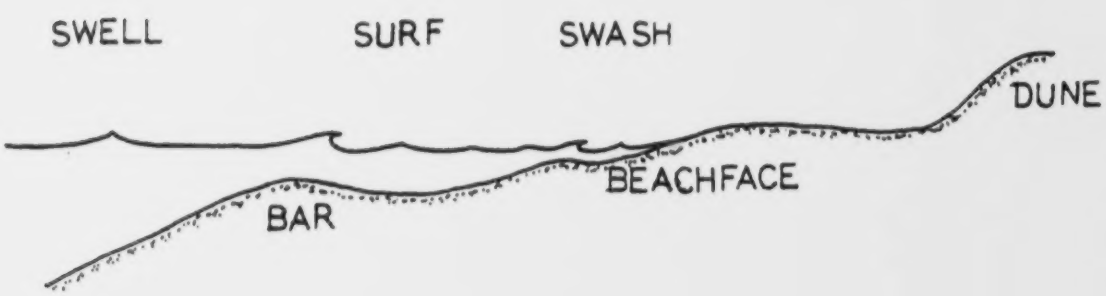
SURF - When a wave finally reaches very shallow water, its shape becomes distorted and it collapses. This occurs when the water depth is equals 1.3 times the height of a wave.

Breaker Depth = 1.3 (H)

1. At what depth will a three foot wave break? 1.3 ( ) = _____

2. At what depth will a ten foot wave break? 1.3. ( ) = _____

3. At what depth will a 15 foot wave break? 1.3 ( ) = _____



THE POWER OF WAVES

An enormous amount of energy is contained in a wave. The total amount of energy is related to wave height. In mathematical terms "the energy in a wave is proportional to the square of the height." This means if you double the wave height, the energy is increased four times!

A 2 meter wave contains 1200 calories of energy per square meter.
A 4 meter wave contains 4800 calories of energy per square meter.

When a wave breaks, there energy is released as the water crashes down. A large wave has many tons of water pressure in it and can do great harm to ships or breakwaters.

How much damage?

Four foot waves once moved a 4500 lb. block of concrete in Florida!
In France, 7000 lb. rocks in a breakwater were thrown over a 20 foot wall!
In an 1872 storm in England a cement and rock breakwater was pushed over by the waves. It was 45 feet long, 26 feet wide, 11 feet thick, and weighed 1350 tons!

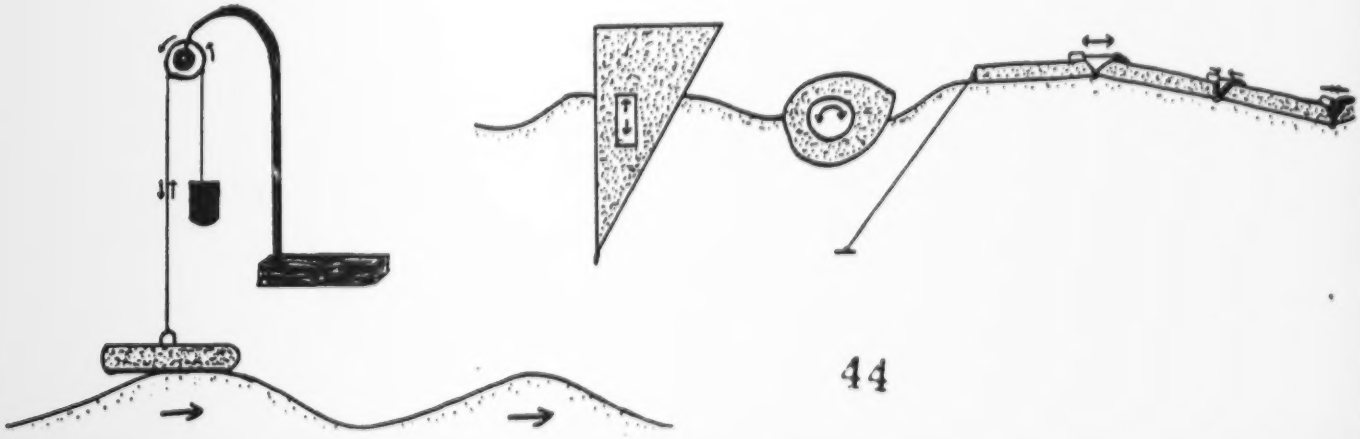
Lighthouse keepers have encountered some of the most damaging waves ever recorded and some lighthouses have been swept away by great waves.

In Oregon, 1912, the window panes in the Tillamook Rock lighthouse were smashed by waves. The panes were 132 feet above sea level!
In 1894, a rock weighing 135 lbs. was thrown over the keeper's house, 100 feet above sea level, and smashed the roof!
In Dunnet Head lighthouse, Scotland, over 300 feet above the water, the windows have been broken by stones cast up by the waves.

Ships, even many of the largest, have been damaged or sunk by waves. The largest wave ever recorded was measured by the crew of the U.S.S. Ramapo in 1933. Its period was 14.8 seconds and it was at least 34 meters high. Fortunately for the crew of the Ramapo it did not break.

How much power is in a wave? It is estimated that a single 1.2 meter wave striking the west coast releases about 50 million horsepower. This is 25 times the power that Hoover Dam produces...in a whole year.

Can we harness all that energy?
Here are several designs for wave-energy machines.



OTHER TYPES OF WAVES

SEISMIC SEA WAVES are giant waves that can be caused by submarine earthquakes or landslides. They move at great speeds and as they approach the shoreline can grow to great heights. Some places that have suffered damage from these waves are Alaska, California and Hawaii.

The Japanese word for these great waves is TSUNAMI.

STANDING WAVES are waves that are enclosed in a basin. The wave you create by jumping into a bathtub is a standing wave. Gently tip a basin full of water and you can watch a standing wave reflect back and forth.

In lakes, a standing wave or SEICHE can be caused by storms or earthquakes.

STORM SURGES are the piling up along the coastline of great amounts of water. This occurs during strong storms and harricanes. As the storm surge approaches the shore, the water level gets higher and higher. Surges can be 20 feet high or more and flood low-lying areas like marshes and beaches.

TIDES are very long period waves. They are caused by the pull of gravity between the earth, moon and sun. The period of a tidal wave is the time between two successive high tides (or crests) of that wave.

THE NEW YORK TIMES, TUESDAY, OCTOBER 25, 1983

SCIENCE WATCH

Great Earthquake Likely Off Alaska as Ocean Floor Slips

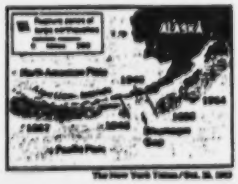
DURING the past decade, intensive monitoring of earthquake activity and tilting of the landscape on the Shumagin Islands south of the Alaska Peninsula has indicated deep slippage of the Pacific floor under that area, increasing stress and making a great earthquake more likely.

The area has been free of major quakes far longer than most of the rest of the zone of frequent earthquake and volcanic activity along the south coast of Alaska and the Aleutian Islands. The zone marks where a plate of the ocean floor, known as the Pacific Plate, is inexorably descending under a plate that forms Alaska and the Aleutians.

For several years seismologists at Columbia University's Lamont-Doherty Geological Observatory have been warning that within the next two decades a very large earthquake is likely to occur in the "Shumagin gap," where a relief of stress is long overdue.

In the Oct. 21 issue of Science they report that the apparent slippage at great depths, now believed to have occurred between 1978 and 1980, would have caused "an increase of stress on the shallow locked portion of the plate boundary, bringing it closer to rupture in a great earthquake."

In the past, earthquakes in this vicinity have generated tsunamis, giant ocean waves that have caused severe damage and loss of life as far away as California and Hawaii. In 1946, an earthquake on Unimak Island, west of the Shumagins, toppled the Scotch Cap lighthouse into the sea and created one of the worst tsunamis on record.



The New York Times/Oct. 25, 1983

Lines across the Shumagin Islands, usually resurveyed yearly, have shown tilting of the land toward the ocean side, presumably caused by the drag of the descending plate. From 1978 to 1980 the tilt reversed, however, a fact taken as evidence for almost three feet of slippage at depths below 23 miles.

Because there had been no indication of stress relief from earthquakes at shallower depths, a major quake may be imminent. A further ominous sign, according to the report, has been the quiescence of Pavlov Volcano nearby on the Alaska Peninsula. Normally, it erupts more often than any other North American volcano.

Authors of the report were Drs. John Beavan, Egill Hauksson, Stephen R. McNutt, Roger Bilham and Klaus H. Jacob.

TIDES

Boating

Winds: Southwesterly, becoming northwesterly, at 15 to 30 knots. **Visibility:** 1 to 3 miles, becoming 5 miles or better. **Wave heights:** 3 to 5 feet on the Sound, 5 to 8 feet on the ocean.

High Tides

Sandy Hook	00:00	12:04 P.M.
Port Jefferson	1:03 A.M.	3:41 P.M.
Shinnecock Inlet	11:14 A.M.	11:47 P.M.
Fire Island	11:28 A.M.	11:58 P.M.
Montauk Point		12:35 P.M.
Stamford	3:01 A.M.	3:39 P.M.

HOMEWORK

1. Fill in the blanks using the formulas at the bottom of page 30.

WAVE

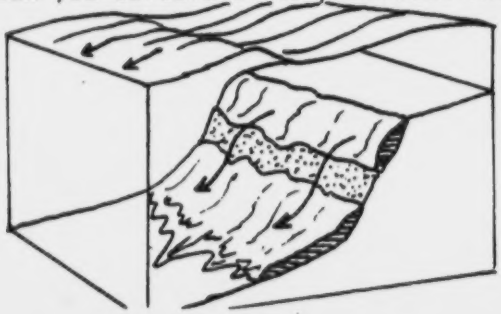
Period (seconds)	Length (feet)	Velocity (knots)
2		
		12
5		
		18
10		
		45
20		

2. At what depth would these waves be expected to break?

Wave Height (feet)	Water Depth (feet)
3	
10	
15	
30	
50	

3. Find information on some giant waves that have caused disasters and write a short summary about them.

4. A tsunami is reported after a submarine earthquake. Its PERIOD is ten minutes. Can you calculate its predicted VELOCITY and WAVE LENGTH?



WAVE DATA SHEET

This form enables you to standardize the data you collect from your wave observations with that of others at different times. Follow the instructions carefully and record your encoded data below.

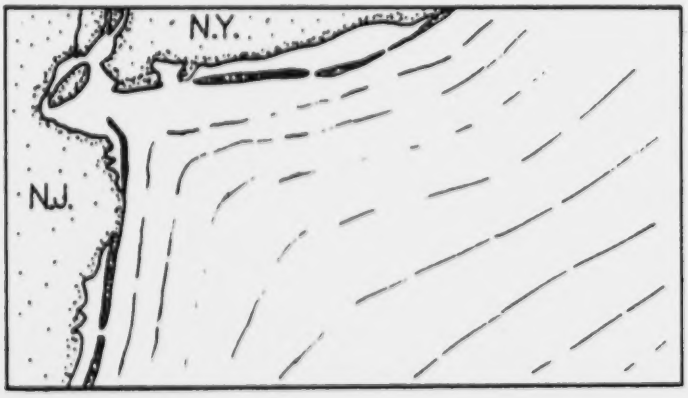
Information	Sequence	Code Numbers	Data
Month	MM	01-12	(_ _)
Day	DD	01-31	(_ _)
Year	YY	01-99	(_ _)
*Octant of the globe	O	0-8	(_)
*Latitude	ddmm	00-90,00-60	(_ _,_ _)
*Longitude	dddmm	000-180,00-60	(_ _ _,_ _)
Hour	hh	00-24	(_ _)
*Wind Direction	wdr	000-360	(_ _ _)
*Wind Speed	ws	00-12	(_ _)
Elevation above sea level	E	0-8	(_)
*Wave Direction	WDR	000-360	(_ _ _)
*Sea State	S	0-9	(_)
Height (average of 10 waves)	HH	00-99	(_ _)
Period (average of 10 waves)	PP	00-99	(_ _)
Length (calculated from averages)	LLL	000-999	(_ _ _)

*(Check charts on reverse side)

Log of Wave Data:

	MM	DD	YY	O	ddmm	dddmm	hh	wdr	ws	E	WDR	S	HH	PP	LLL
Site #1															
Site #2															
Site #3															
Site #4															
Site #5															

Waves approaching the coasts around New York Harbor.



O

OCTANT OF THE GLOBE

	Code
North latitude	
0°W to 90°W	0
90°W to 180°W	1
180°W to 90°E	2
90°E to 0E	3
South latitude	
0°W to 90°W	5
90°W to180°W	6
180°E to 90°E	7
90°E to 0°E	8

E

ELEVATION OF WIND MEASUREMENT ABOVE SEA SURFACE

	Code
0-9 feet	0
10-19 "	1
20-29 "	2
30-39 "	3
40-49 "	4
50-69 "	5
70-89 "	6
90-130 "	7
Greater than 130	8

wd/WD

Wind/wave Direction

Calm	000°
North	001°
East	090°
South	180°
West	270°

S

STATE OF SEA—WIND WAVES

CODE	DESCRIPTION	HEIGHT (Feet)
0	Calm—glassy	0
1	Calm—rippled	0-⅓
2	Smooth—wavelets	⅓-1⅔
3	Slight	1⅔-4
4	Moderate	4-8
5	Rough	8-13
6	Very rough	13-20
7	High	20-30
8	Very high	30-45
9	Phenomenal	over 45

Equations:

Period = .33 (Velocity)
Velocity = 3 (Period)
Length = 5 $(Period)^2$

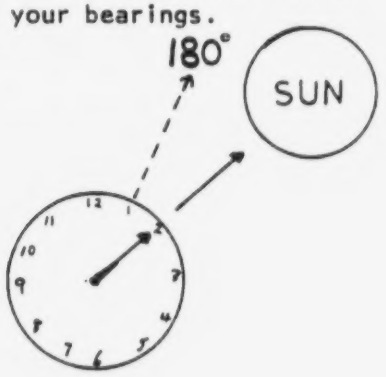
WS

Beaufort wind scale

		CODE
Calm	Less than 1 knot	00
Light airs	1-3	01
Light breeze	4-6	02
Gentle breeze	7-10	03
Moderate breeze	11-16	04
Fresh breeze	17-21	05
Strong breeze	22-27	06
Moderate gale	28-33	07
Fresh gale	34-40	08
Strong gale	41-47	09
Whole gale	48-55	10
Storm	56-63	11
Hurricane	64 and above	12

Compass readings:

If a compass is not available, use the "watch" method to find south and then your bearings.



Session 7 - The Moving Beach

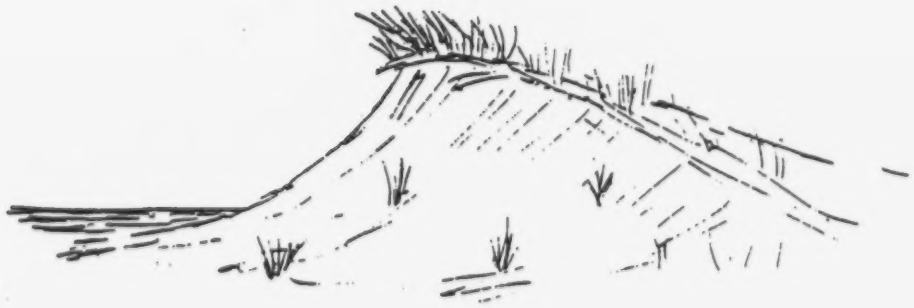
The Moving Beach - The geological history of Sandy Hook. Dunes, beaches, sand and minerals, topography, map and chart reading.

Location - Meet at "Topic" Headquarters - Sandy Hook.

Materials - Bring ziplock bags for sand and shell samples. Maps, shovels, and survey equipment will be provided.

Acitivity: A hike around the Hook from the perspective of a geologist.

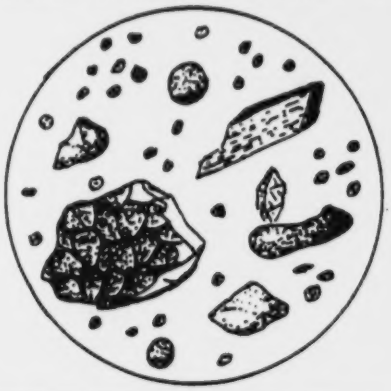
Assignment - "The beaches are moving..." Using your own maps and a brief explanation, predict what Sandy Hook will look like in 100 years. Justify your answer.



SAND STUDIES

A beach is composed of whatever material is deposited there by the waves. The sizes and types of beach material depend on where it comes from and what physical forces act on it.

At Sandy Hook, the beach is composed mainly of quartz, but contains many other materials too. Under a microscope, these particles can be sorted and identified according to their shape and color. Take a dried sand sample from the beach to see how many of these you can identify.



BEACH MINERALS	DESCRIPTION	COLOR
QUARTZ	silicon dioxide	white if pure; but varies in color
FELDSPAR	any of a group of minerals, principally aluminosilicates of potassium, sodium and calcium.	pink
MAGNETITE	an oxide of iron	black
GARNET	any of a group of hard vitreous minerals, silicates of calcium, magnesium, iron or manganese with aluminum or iron	varies in color, red is common
TITANIUM	oxide of the heavy metal titanium	dark gray, black

INSTRUCTIONS

Please take a few moments to read all these instructions and only use equipment that you have been trained to use. Instruments like microscopes and balances are sensitive and easily damaged. Carry equipment with both hands, clean it and your area when finished, and put everything away when you have completed your studies.

Equipment Check List

____ Microscope

____ Petri dish

____ Balance

____ Forceps

____ Lights

____ Geological Seives

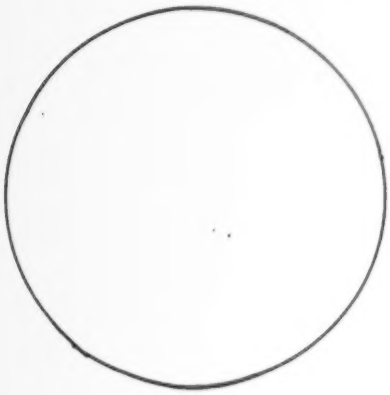
____ Geological Shaker

____ Magnet

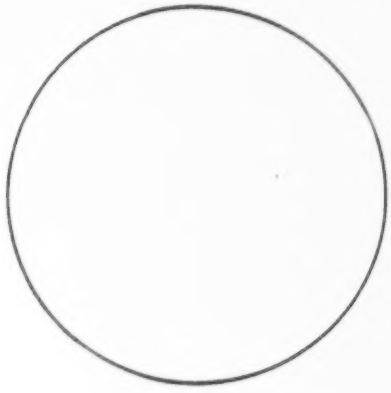
____ Ruler

SAND IDENTIFICATION SHEET

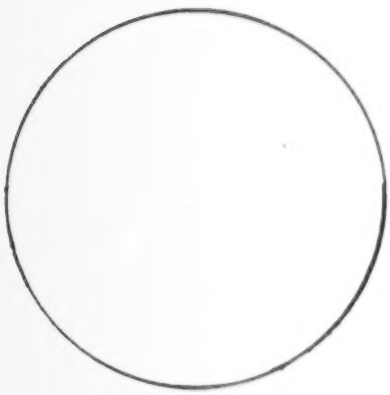
Sand from different areas looks, feels and is different. Carefully analize your samples. Pay particular attention to size, shape, color and transparency.



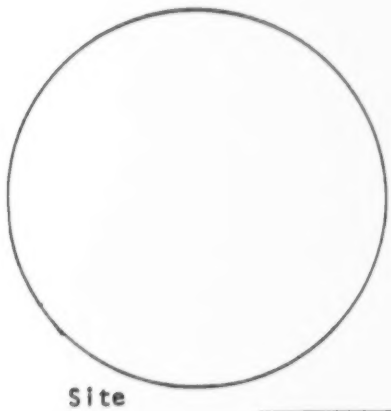
Site _____
Size _____
Major Constituents _____
Minor Constituents _____
_____
_____



Site _____
Size _____
Major Constituents _____
Minor Constituents _____
_____
_____



Site _____
Size _____
Major Constituents _____
Minor Constituents _____
_____
_____



Site _____
Size _____
Major Constituents _____
Minor CConstituents _____
_____

SAND ANALYSIS SHEET

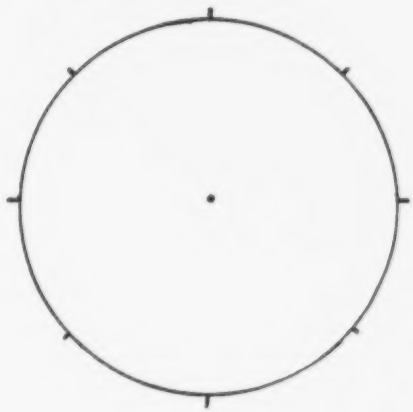
There are several ways that sand can be analized and presented. Take the data you have collected and enter it into the formats below.

Data

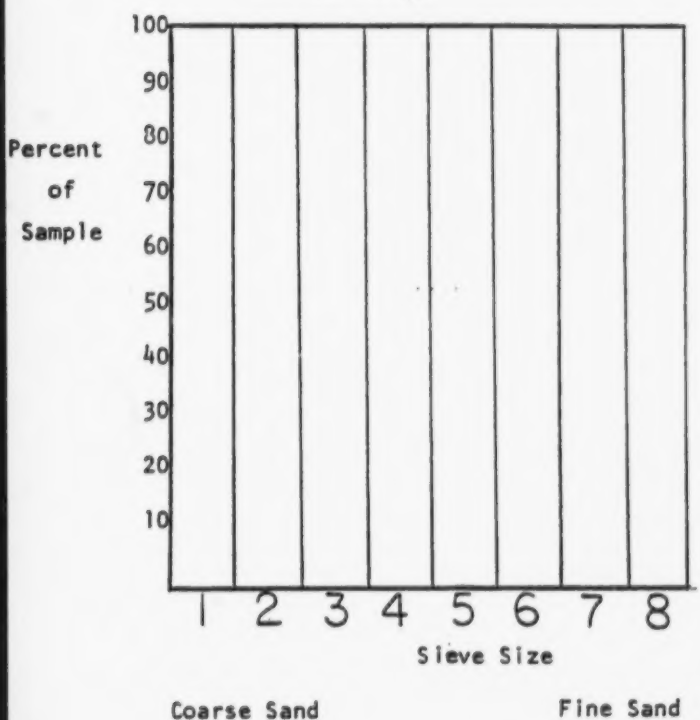
Sieve Size	Weight	Accum.Weight	Percentage
1			
2			
3			
4			
5			
6			
7			
8			

TOTALS

Pie Graph

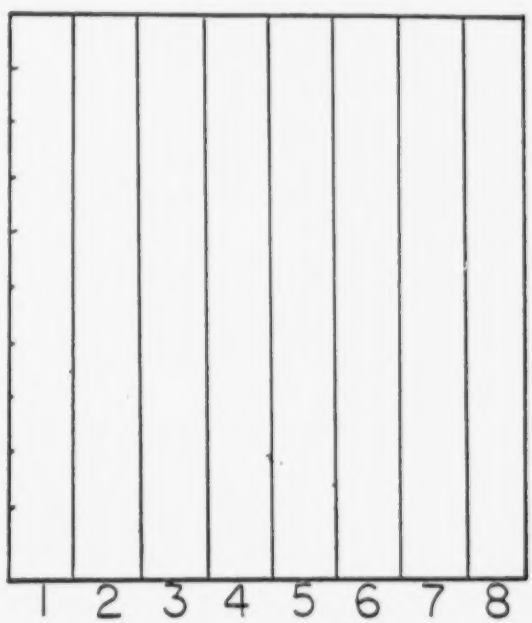


Bar Graph

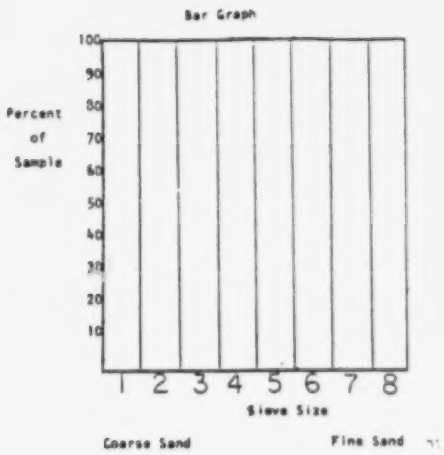


%

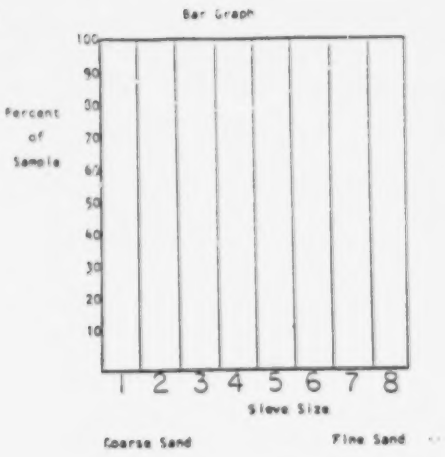
Simple Graph



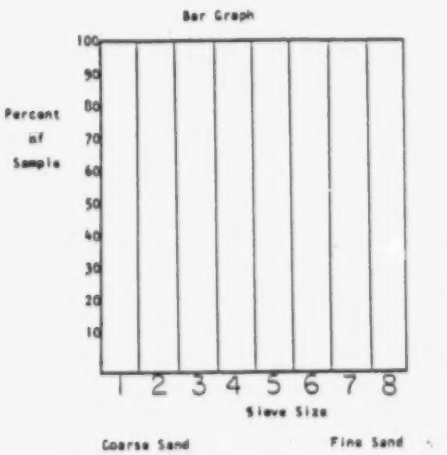
SAND COMPARISON SHEET



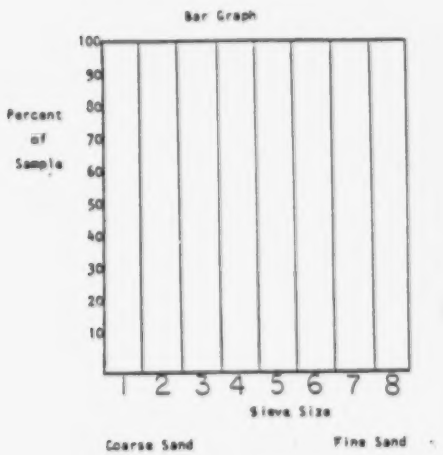
Sand Sample_____



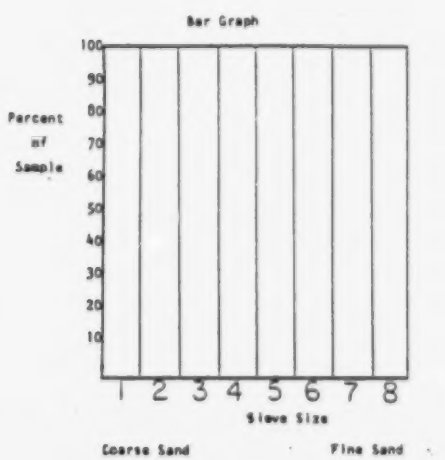
Sand Sample_____



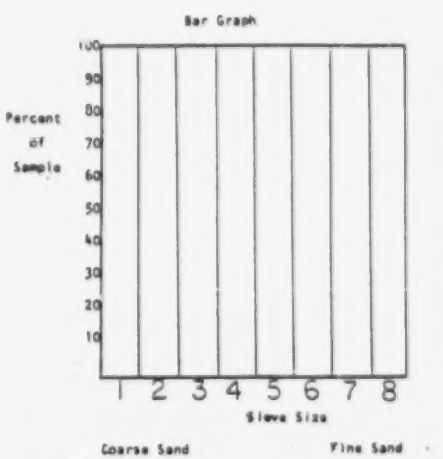
Sand Sample_____



Sand Sample_____



Sand Sample_____



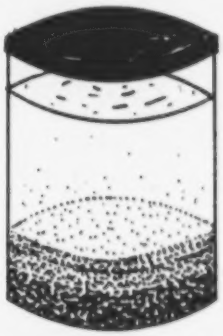
Sand Sample_____

SAND SETTLING EXPERIMENT

Sand particles are of many different sizes, shapes and densities. These particles can differ in settling rates in water and this will affect where they are deposited on the bottom. As a general rule, larger particles settle first and smaller particles take longer to sink to the bottom.

For water to move sand, it must have enough energy to do the work. Therefore, what would take more energy (current speed) to move...a small particle or a large one? What would take more energy to move...a light particle or a dense particle?

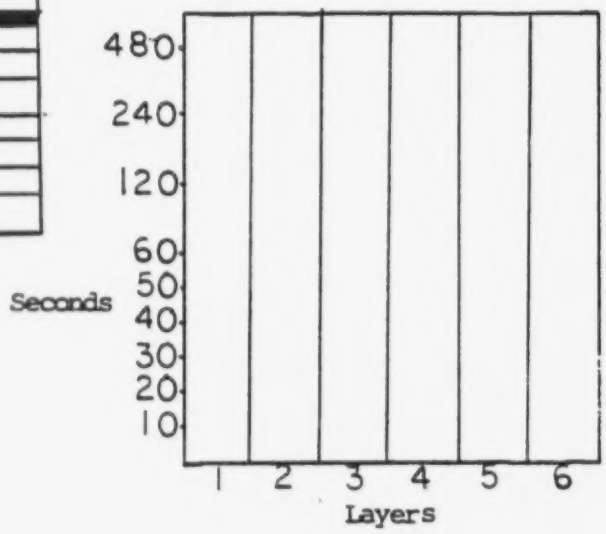
Let's experiment and find out.



1. Fill a straight-sided jar two thirds with water and one third with a sand sample.
2. Close the lid tightly and shake for five minutes.
3. Observe and time the settling rates of the different particles. This may take up to 30 minutes. (Caution: Large pebbles could crack the glass. Remove before you start.)

Measure the amounts of each particle type (constituents) and approximately how long it took to settle. Fill in the data sheet, then complete graph.

Constituent	Particle	Settling Time	Amount	Percent
Layer 6				
Layer 5				
Layer 4				
Layer 3				
Layer 2				
Layer 1				
Totals				



Can you draw any conclusions about the size and types of particles, and their behavior in water. Which are easier for water to move? Which drift longer?

Study this chart. Indicate where these particles might settle on the bottom.(Shore,Deep Ocean) Remember, you need energy to move anything.

Particle	Size MM	Settling Location
Clay	<1/256	
Silt	1/256-1/16	
Sand	1/16-2	
Granule	2-4	
Pebble	4-64	
Cobble	64-256	
Boulder	>256	

Homework

1. Write a "geologists" description of your sand sample. Use terms that were discussed in class. (Crystal, Plished, Fine, Course, Transpatent, Opaque, etc.

2. Analize soil or sand from your neighborhood. Compare it with what you analized here today.

Session 8 - The Battle of Sandy Hook

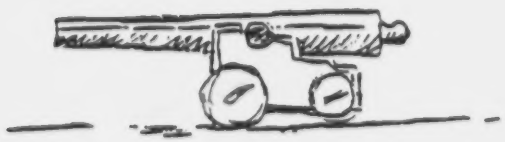
The Battle of Sandy Hook - The military history of Fort Hancock. Life in the 1700's and 1800's is explored. Why was Fort Hancock built? Why was Sandy Hook chosen as a military reservation, and evertually as a park?

Location - Meet at "Topic" Headquarters, Sandy Hook.

Materials: A brief history of Sandy Hook is enclosed.

Activity - A historical view of Sandy Hook and its development. Bunkers, homes, and the museum are explored.

Assignment - Having already experienced Sandy Hook in different seasons and from the perspective of a biologist, geologist, mariner and engineer - be a historian for a few moments. Pick a time and place in Sandy Hook's history and describe the days activities if you were: a soldier, sailer, fisherman, surfman or other official (or unofficial) visitor to the Hook - be creative.



HISTORY

Sandy Hook was destined to play an important part in history because of its nearness to the sea, its strategic location at the mouth of New York harbor and its natural features. The Hook's value has changed with time. Once dreaded as a hazard to navigation, it is now one of New Jersey's most popular vacation areas. Trace Sandy Hook's history backwards using this outline and refer to it on your history tour.

Today-Approximately 300 people live and work at Sandy Hook on a regular basis. Most are associated with the National Park Service, the U.S. Coast Guard, N.O.A.A. and several school groups. Depending on the season 30 thousand daily visitors will stay from one to 24 hours. Most visit in the summer and spend their time sunning, swimming or fishing. However, many thousands also come here in the colder months to hike or relax and enjoy the scenery.

Today Sandy Hook is a park - a National Recreation Area. Since 1973 its 1664 acres have been permanently set aside for all forms of water-oriented recreation, nature study and historical preservation.

1984-The Corps of Engineers completed the dredging of $15,000,000 worth of sand to fill the breach that destroyed the Hook's only access road in October 1982.

1980-(May) Sandy Hook was reopened this week after being closed for almost 6 months for safety reasons. Unexploded ordnance, some of it still live, and weighing up to 1000 pounds, has been surfacing along the beaches where erosion is occurring. The shells are of the 1874-1917 era when the army test fired over three million rounds at its proving grounds here.

1973/74-Military Era ends. National Park Service takes over Sandy Hook.

1950's-Sandy Hook enters the rocket age. Nike anti-aircraft missiles are installed at Sandy Hook to protect New York City.

1941/45-World War II. Population of the Hook is around 17,000 troops. Most stay only a short time for training and processing before being shipped out of Hoboken for Europe.

1917-World War I. Seven thousand troops at the Hook for defense weapons testing and training.

1890's-About 700 troops stationed at Sandy Hook for defense and weapons testing. Troop strength increased during Spanish-American War. New harbor defenses and batteries constructed.

1874-The army designates Sandy Hook as its first official ordnance proving grounds where all of its guns and explosives will now be tested.

1859-Construction begins on a huge granite fort at the tip. This continues during the Civil War. but the fort is never finished. This fort area was surveyed by Capt. Robert E. Lee in the 1840's.

1849-U.S. Life-Saving Service builds station at Spermaceti Cove.

1817-The army buys the southern half of Sandy Hook.

1812-The British navy blockades New York Harbor. 57

1806-The army buys the northern half of Sandy Hook from the heirs of Richard Hartshorne.

1782-Loyalists depart Sandy Hook for Nova Scotia and the Bahamas, after holding the Hook throughout the war.

1778-(July 5) General Clinton's army of 1,200 evacuates Sandy Hook by ship at Horseshoe Cove after the Battle of Monmouth.

1764-(June 11) Sandy Hook Lighthouse is first lighted.

1678-Richard Hartshorne pays Navesink indians 13 shillings for Sandy Hook.

1677-Richard Hartshorne acquires Sandy Hook and uses it to graze livestock and cut wood.

1600's-Area disputed by British and Dutch

1609-Henry Hudson anchors at Sandy Hook and explores the area of Highlands.

1524-Giovanni Verrazano explores the area.

References: Sandy Hook and The Land of The Navesink - Sam Smith
Nauvoo to the Hook - George Moss

Museum Visit-Use this space for notes about these aspects of Sandy Hook's history...

Aid to Navigation

Life Saving Station

Military Outpost

Proving Grounds

Missile Battery

Recreation Area

QUIZ

1. How high is the Sandy Hook light?

2. How far can it be seen at night?

3. What year was it built?

4. Who was Ft. Hancock named after?

5. What gun is at Sandy Hook?

6. What explorer first sighted Sandy Hook?

7. What British general was forced to evacuate his troops from Sandy Hook?

   a. Washington b. Clinton c. Halyburton d. Lee

8. Who was the person who surveyed Sandy Hook in the 1840's and went on to become a famous general?

9. When was the War of 1812 fought with the British?

10. List two important aspects of Sandy Hook besides its military use.

Suggested Activities

1. Read up on the human history of Sandy Hook. An excellent article on life at the Hook around the turn of the century is:

   "Sandy Hook in 1879"by George Houghton

   It is available at the Sandy Hook Visitor Center and the Twinlights Museum.

2. Pick a time in Sandy Hook's history and write a personal narrative of a person who lived there during that time. Include: who you are; why you were there; what you were doing; and how your life was affected by being there. Title: "A Day in the Life Of...."

3. Write a poem about Sandy Hook's historical features. You might want to chose a particular event or place to write about, or the feelings you have after visiting there. Topics: Ware and Peace, The Ghosts of Fort Hancock, Shipwrecks, The Retreat of the British Army-1778, Indian Life at Sandy Hook.

4. Pick out a famous person whose name is associated with Sandy Hook. Write a short biography of them and see what part of their life was spent at Sandy Hook or involved with it. Suggestions: Verrazano, Hudson, Richard Hartshorne, Penelope Stout, George Washington, General Henry Clinton, Lieutenant Hamilton Halyburton, General Winfield Scott Hancock, Dr. William Newell, Tom Mix. (Sources: Sandy Hook and The Land of The Navesink - SMITH
   Nauvoo to The Hook - MOSS
   Sandy Hook in 1879 - HOUGHTON)

Session 9 - S.O.S.

S.O.S. - Save Our Shoreline - Human activities along the shore. Engineering attempts to control the shore. Development pressure, preservation as parks, commercial use - these human factors will be considered in assessing the benefits and costs of living and working along the coast. Visit to Twin Lights Museum included.

Location - Meet at the Twin Lights Museum - Highlands.

Materials - Examples of N.P.S./Beach Restoration Plans.

Activity - A visit to Twin Lights will give the students an overview (literally and figuratively) of Sandy Hook and the "Topic" program.

Assignment - Local maritime history will also be stressed.

SANDY HOOK - Is It Disappearing or Growing?

In spite of all of the changes that have occurred over the last 200 or so years that we have illustrated on detailed maps, Sandy Hook has remained approximately the same size. Inlets have formed, then closed again. Beaches have disappeared at one end and reappeared at the other. These events are all part of an ongoing process that will occur as long as waves crash along our shores.

The problems at Sandy Hook - erosion, flooding, wave damage - are also occurring all along our coasts. The causes of these problems are both natural and human.

Natural causes include:

storm flooding (surges)
littoral transport (moving beaches)
sea-level rise (about a foot per century)

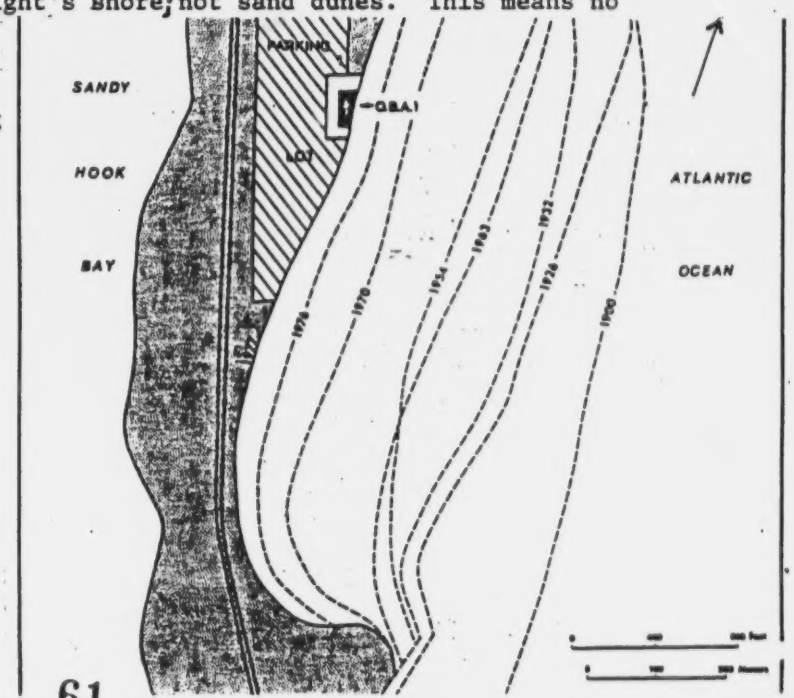
Human causes include:

building too close to the water
building on the beach
destroying dunes
building jetties and groins

At Sandy Hook the beaches are moving northward most of the time because most of our wave action is from the southeast. Sand is eroded from the southern portion and deposited at the northern portion. In a natural system, without human interference (jetties, etc.), the beach responds to the ocean by migrating in the direction that the waves and currents push it (inland and northward in the case of Sandy Hook).

Groins were built to trap the sand in Sea Bright, Monmouth Beach and Long Branch and a seawall exists along Sea Bright's shore; not sand dunes. This means no new sand reaches Sandy Hook.

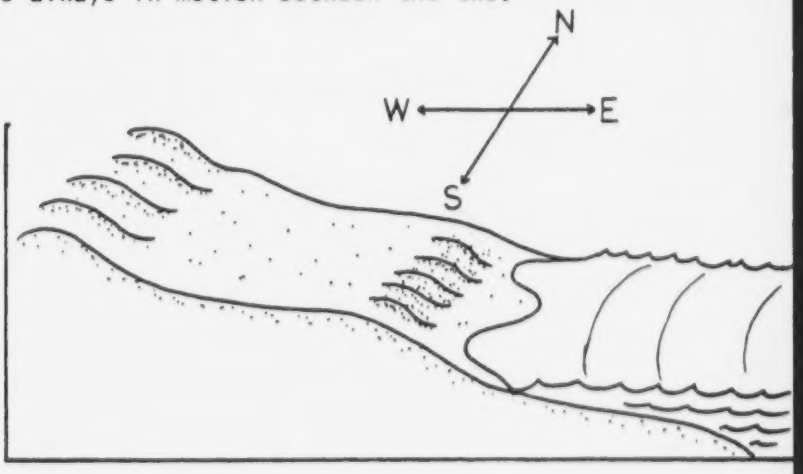
Since sand is continually shifting north, an inlet is forming at the "critical zone". Various engineering strategies have been suggested to solve the problem. These include: doing nothing (letting an inlet form), building groins and pumping sand. So far at least $15,000,000 has been spent pumping sand.



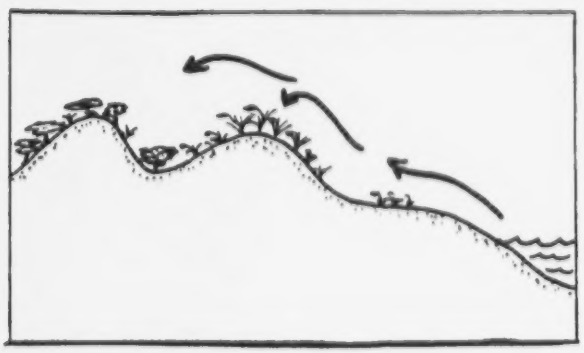
HOW BEACHES MOVE

Sand is light and easily moved by wind and water. This is why we have beaches along our coasts. Think of the physical processes that create sand by breaking up or moving rocks.... wind erosion, water erosion, streams, rivers, waves and currents. These forces carry sand down to and along our shores. Once there, the sand is continually sifted by the waves and currents that are always present. This shifting mass of sand is called a beach. It's difficult to classify the beach as land or sea, because it is always in motion between the two.

Beaches can move by WIND action. Light sand is easily piled into dunes by the winds when it is carried away from the shoreline. On this beach, which winds would build up the beach? Which winds would remove sand?

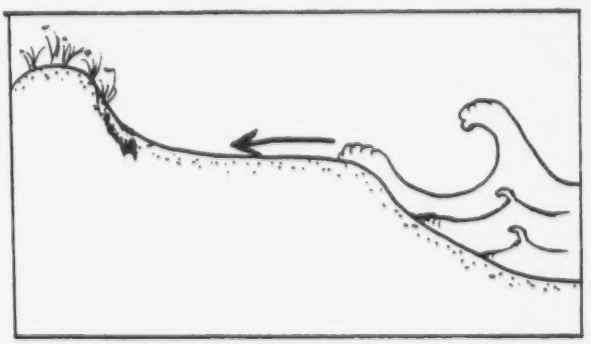


Ocean winds tend to carry sand inland and land breezes carry the sand back out to sea.

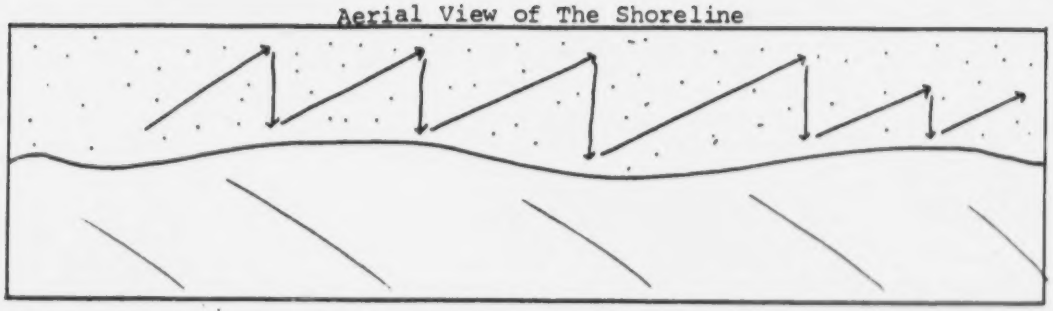


In our area the tendency is for beaches to migrate towards the land. Dunes form where plants grow to trap the moving sand.

WAVES move sand whenever they crash against the shore. Sand grains are pushed in the direction that the wave or swash from the breaking wave is traveling. This sand movement is towards the land and up onto the beach.



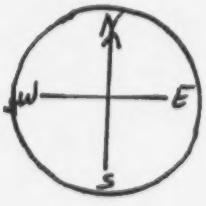
Aerial View of The Shoreline

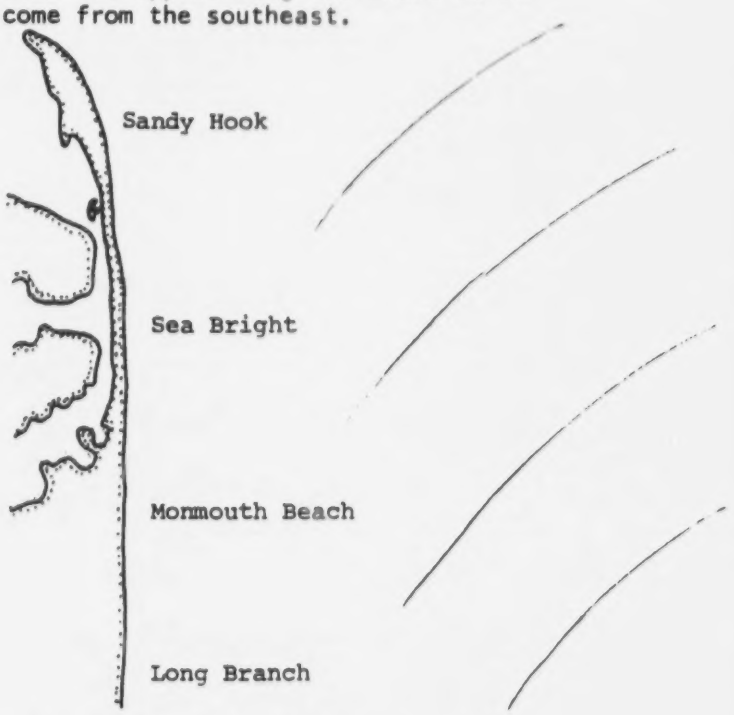


Sand is moved along the beach if the waves are approaching the shore at an angle. In our area the waves tend to come from the southeast.

Can you see how Sandy Hook gets its shape? Where does the Hook get its sand? Where does Sea Bright get its sand?

Illustrate this movement using arrows between those points.





Wind, Waves and Currents are the forces that move the beach. We label the effects of these forces erosion or deposition. But this depends on whether the place we are viewing is losing or gaining sand at that particular time. Sand is always being moved. If one beach is losing sand (erosion), another beach will gain that sand (deposition).

In the picture above, can you tell which beaches are the losers and which are the winners?

Define these terms:

Swash _____

Littoral Drift _____

_____

Longshore Current _____

_____

Beach _____

Jetty _____

Groin _____

Spit _____

Berm _____

Dune _____

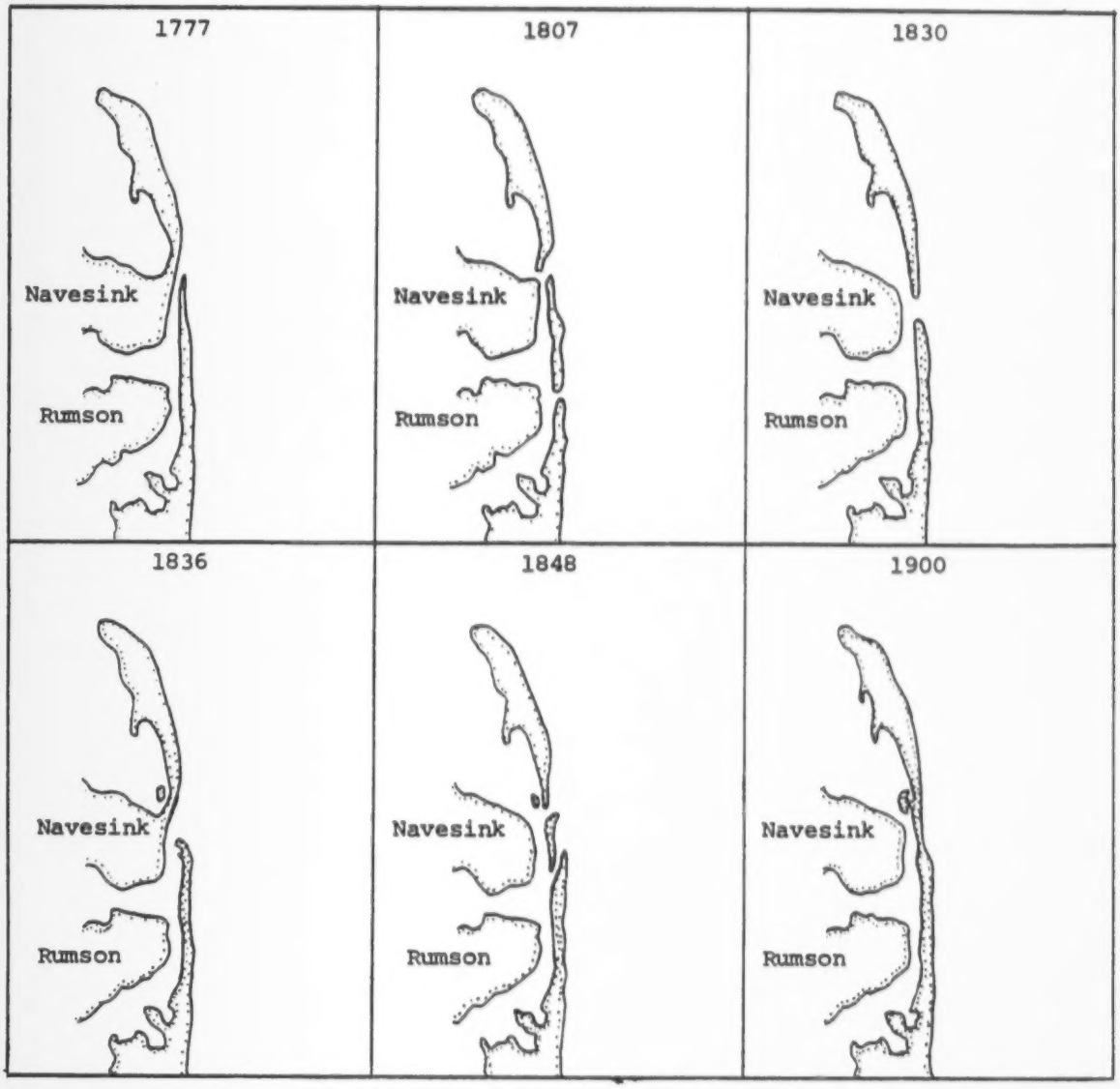
Over wash _____

SAVE OUR SHORELINE

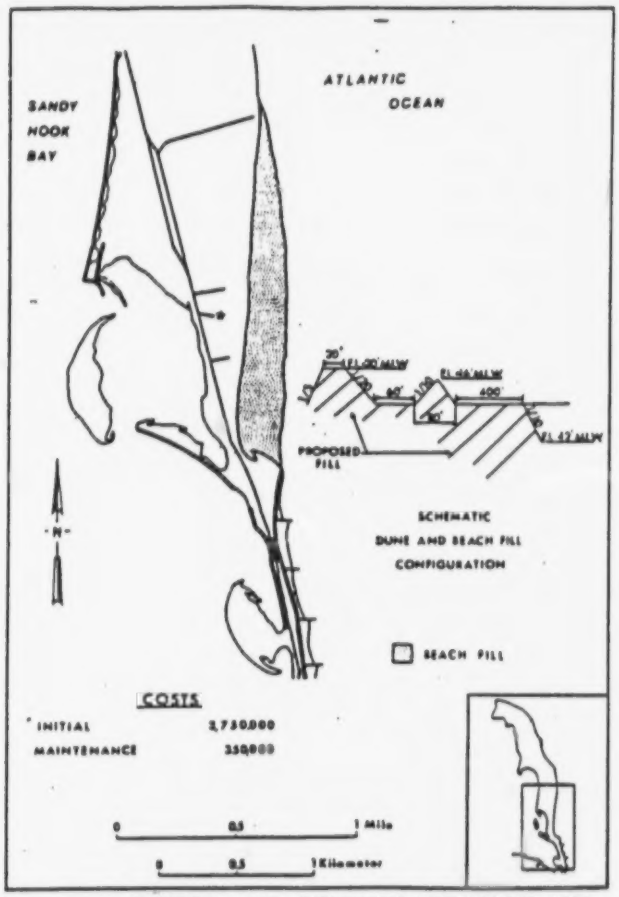
The Sandy Hook Lighthouse was first lighted in 1764, giving mariners a fixed reference point to avoid grounding their ships and guide them safely into New York Harbor. To be most effective, the light was placed on the shore of the farthest point of land in the area... the tip of Sandy Hook.

Today if mariners used that same "safe passage: of the 1700's they would surely run aground. The lighthouse is no longer on the tip of the Hook, but 1½ miles from it! Shifting beaches have filled the old channel and created hundreds of acres of new "land."

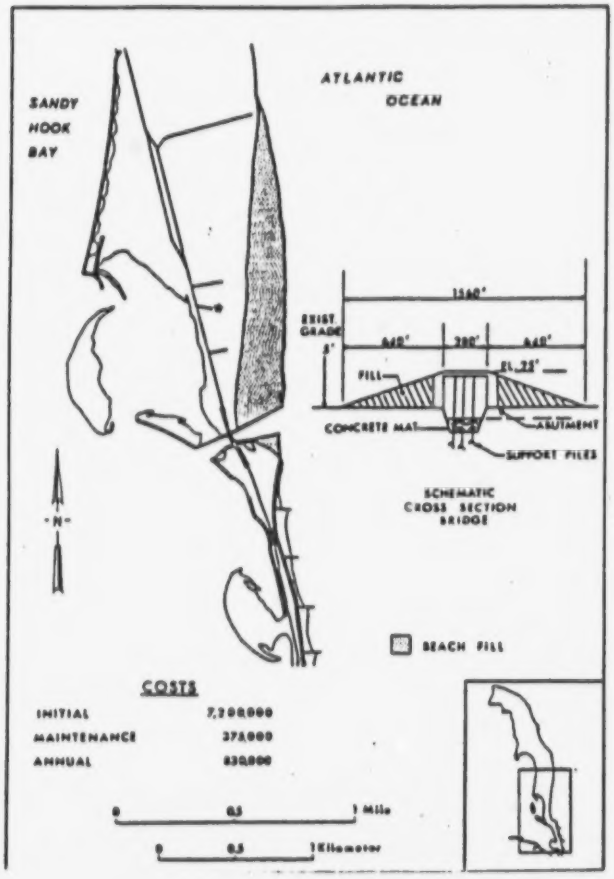
We usually only hear stories about beaches eroding and land disappearing into the sea. However, here is an example where a beach is not only growing larger, but becoming a hazard to navigation! We shall see that both the erosion of beaches and building-up of beaches are part of the same process.



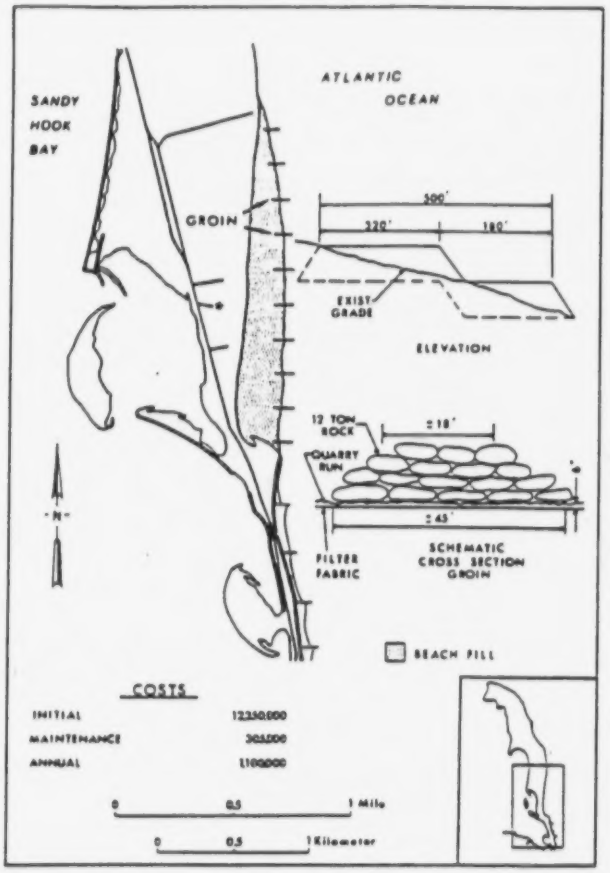
BEACH NOURISHMENT ALTERNATIVE



BRIDGE AND CONTROLLED INLET ALT



GROINS ALTERNATIVE



Here are three plans for saving the Hook. Look at each one carefully and decide which one is the best.

Consider the cost of each and how effective it will be. Can you think of another alternative? Put your ideas on the next page.

Plan I Cost_____ Life of Project_____ Effectiveness? Problems?	Plan II Cost_____ Life of Project_____ Effectiveness? Problems?
Plan III Cost_____ Life of Project_____ Effectiveness? Problems?	Your Plan Cost_____ Life of Project_____ Effectiveness? Problems?

TWIN LIGHTS

The Highlands of Navesink offer unique views of: Sandy Hook, that portion of the Atlantic we call the New York Bight, three rivers - Shrewsbury, Raritan and Hudson, and New York City.

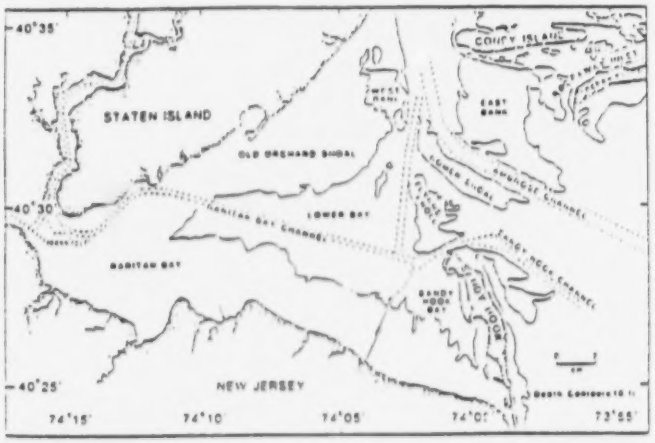
This "bird's eye" view, some 200 feet above sea level, is the highest along the coastal plain of the eastern United States. Therefore, it's no accident that such a prominent point has had such an important role in the history of our area.

Geography and Geology of the Area

First orient yourself. To the North is New York City, approximately 22 miles from here. To the right of N.Y.C. is Long Island (northeast). To the left of N.Y.C. is Staten Island (northwest). Directly east is the Atlantic and in the foreground is the penninsula called Sandy Hook. While you are up here today consider:

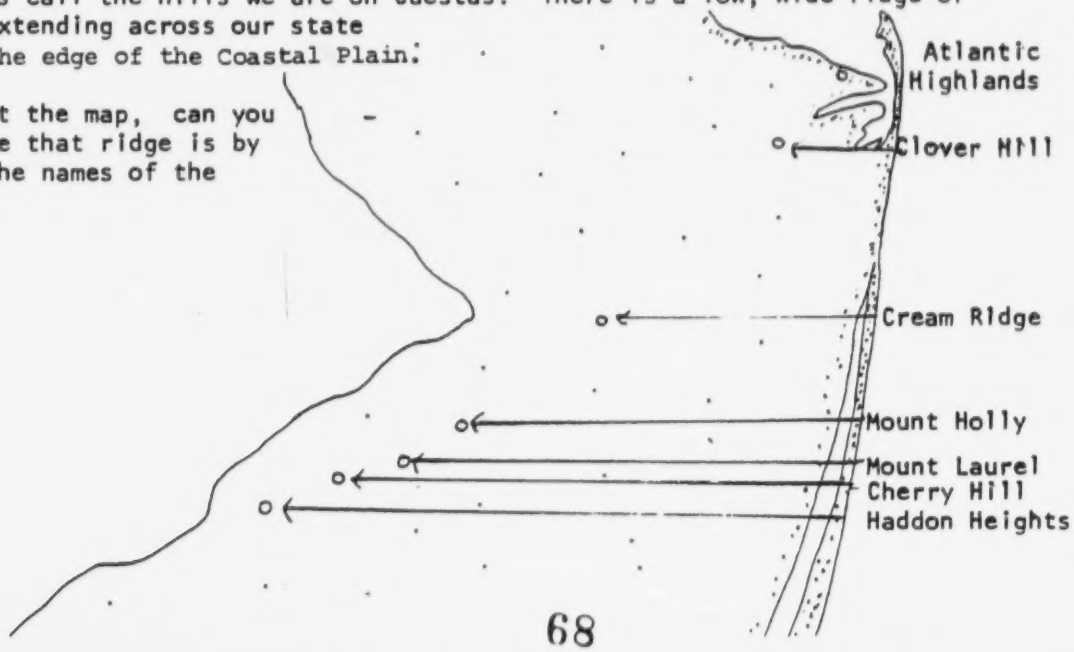
How this view looks now, what it may have looked like in the past, and how it might look in the future.

The land and sea are at odds here, therefore, the landform is always changing - it is dynamic.

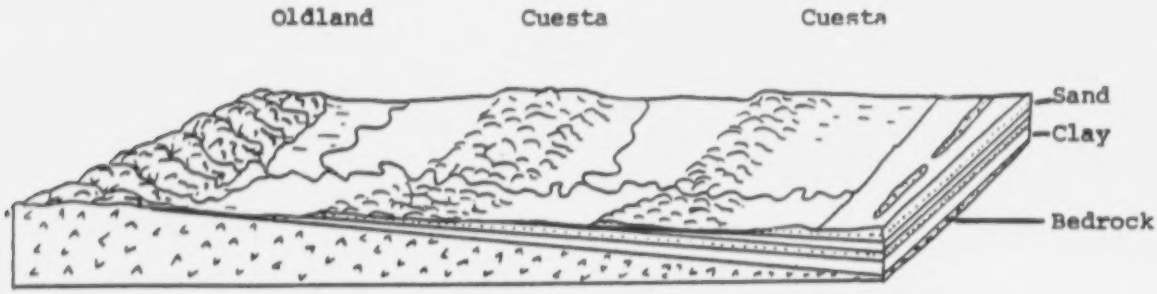


Geologists call the hills we are on Cuestas. There is a low, wide ridge of cuestas extending across our state marking the edge of the Coastal Plain.

Looking at the map, can you tell where that ridge is by reading the names of the towns?

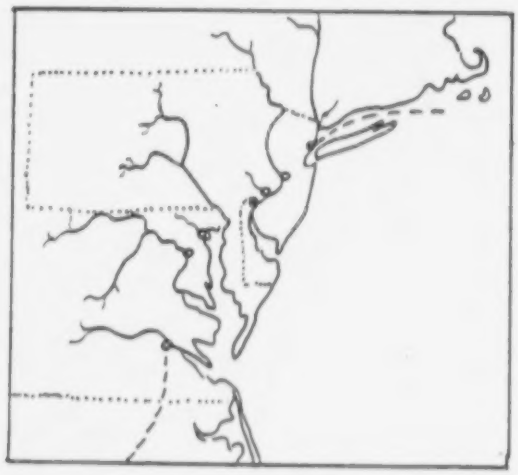


Low hills like these and the flat lowlands next to them are typical features of the Coastal Plains - a region that formed under water when the seas covered much of the land. Sandy soils, sedimentary rocks and the fossils of ancient marine creatures are commonly found here.



To find where the coastal plain lowlands begin and the rocky uplands or oldlands end, you merely have to trace a line through the major cities of the eastern seaboard.

Can you think of any reason why our largest and most important cities were established at these points along major rivers?

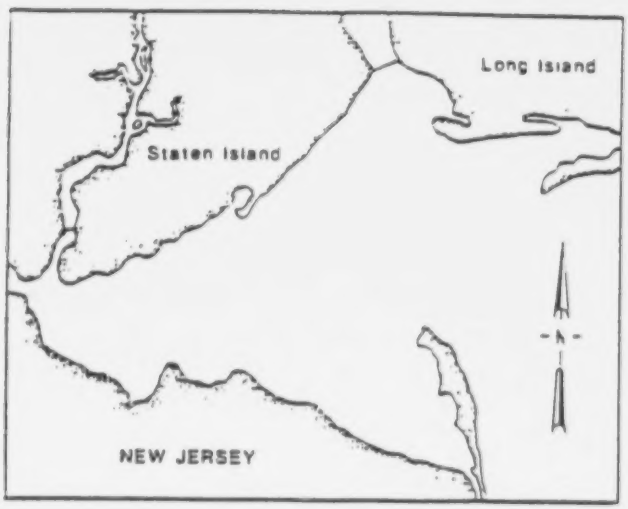


The Coastal Plain is wide (100-300 miles) and extends from Long Island to the Gulf of Mexico: a distance of over 2000 miles! Its geological history makes it flat and easy to farm or build on. It also has sand, clay and fuel deposits that are valuable economic resources.

LANDMARKS

Look and locate the following:

1. Sandy Hook Lighthouse
2. The Verrazano Bridge
3. Raritan Bay and Sandy Hook Bay
4. The Navy Pier - E.A.R.L.E.
5. Coney Island
6. Long Island
7. Eastern Long Island
8. Ambrose Light
9. Sea Bright
10. The Shrewsbury River
11. Vessels (Commercial, Recreational, Military, Oil tanker, Tug, Barge, Cruise)



HOW FAR CAN YOU SEE?

The distance you can see to the horizon increases with your elevation. You can figure this out using the formula:

$\sqrt{\frac{3}{2} \cdot E}$ or the square root of 1.5 times elevation

Calculate how far you can see to the horizon.

Elevation = _____ feet
1.5 x _____ Now find the square root of this number.
$\sqrt{\quad}$ = _____ miles to the horizon

SANDY HOOK

From our "bird's eye" view, let's study the geological history of Sandy Hook. When Ice Age glaciers covered the northern part of New Jersey and Long Island, the area below us was a river valley. The shoreline was east of us over the horizon - at least 50 miles away! As the earth warmed and the glaciers began to melt 12,000 years ago, the oceans filled with melt waters and the outermost coastal plain was flooded. This is a process that continues today and Sandy Hook is proof of that. As the level of the sea has risen, wave erosion along the bluffs we call Long Branch, Rumson and Highlands has moved sediments north to form the peninsula or "sand spit" that is Sandy Hook. Sea level is still rising at a rate of 12-18" a century, threatening to flood many of our coastal areas. Some topics to think about as you look out over this scene are:

How long will it be before towns like Highlands or Sea Bright will be flooded?

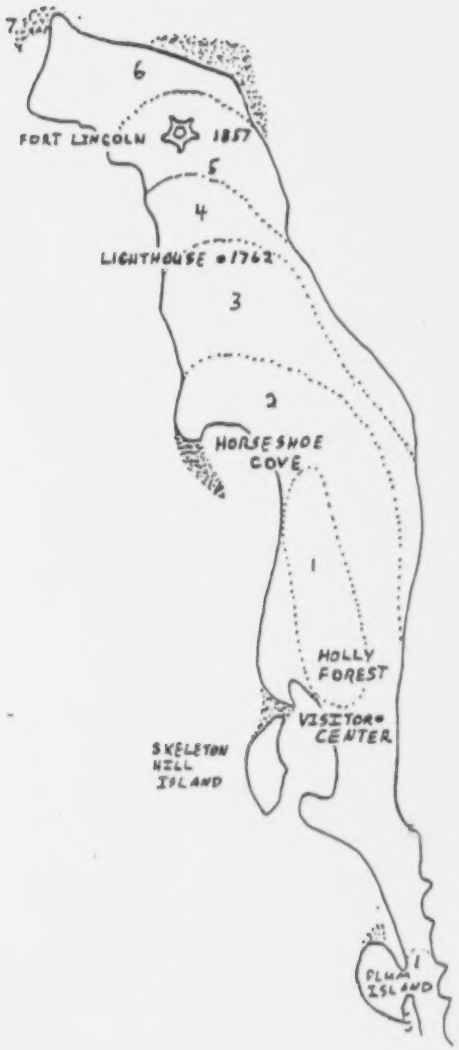
How long before the Hook is again breached by the sea?

Where are the most flood-prone areas along the peninsula?

Where is it most likely to be breached?

Our Beaches are a natural "shock absorber" between the land and the sea. This is why they are called "barrier beaches". Look at the shape of Sandy Hook's northern portion. It is not uniform, but variable. This jagged shape is a very logical pattern if you understand how a spit develops.

Using the key, color in Sandy Hook to illustrate its geological history.



Color Code

1 - Brown (Before 1600's)

2 - Yellow (1600's)

3 - Orange (1700's)

4 - Red (Early 1800's)

5 - Blue (1800's)

6 - White (1900's)

7 - Dots (1984)

Heroes at the Highlands

The Twin Lights Museum contains a superb collection of artifacts, paintings and photographsof historical interest. A giant "first order" Fresnel lens is displayed, along with a replica of Marconi's "wireless telegraph".

"Local" history includes vessels that were designed and built for New Jersey's waters, including:

The Fox - a Sea Bright skiff that was rowed across the Atlantic by two Highlands fishermen, Frank Samuelson and George Harbo.

A Francis Lifesaving Car - built by Joseph Francis of Toms River for rescue work by the U. S. Life Saving Service.

Spermaceti Cove Life Saving Station - originally at Sandy Hook, is restored and open to the public. The Life Saving Service which later became the Coast Guard, was the idea of a Monmouth County congressman, William Newell.

Other less-famous, but important people and events are exhibited here. Handouts on each are available at the museum and from your teacher. Study these before your visit to the museum.

ACTIVITIES

1. Numerous famous events and people are described in handouts available at the museum. Choose one and present a short summary to the class.

Suggestions: The Life Saving Service -(More than a pleasant walk on the beach?)

Twin Light's Mystery Cannon -(Pirate gun or lighthouse keeper's lampoon?)

Ships That Sailed to Nowhere -(Another waste of the taxpayers' money?)

New Jersey's First Inhabitants -(The original "Real Men".)

The Barnegat Sneakbox -(N. J.'s first smugglers?)

Jersey Born and Bred -(Another Springsteen song?)

2. Study the refraction of light, which is governed by Snell's Law. Explain how a Fresnel lens works.

3. It is estimated that Sandy Hook developed at a rate of 40' per year. How long has it taken to grow from the Highlands Bridge area to the tip?

$$\frac{\text{(Length of Sandy Hook in miles X (feet in a mile)}}{\text{Growth Rate in feet per year}} = \text{(Approximate Age in Years)}$$

TEST

1. How high is Twin Lights? _____

2. During which war was Twin Lights built? _____

3. Why were two lights built? _____

_____

4. How far have the lights been spotted at sea? _____

_____

5. What did Augustine Fresnel invent? _____

6. Who were Harbo and Samuelson? _____

_____

7. Who invented the wireless telegraph? _____

8. If your elevation is 96 feet, how far is the horizon visible?

$\sqrt{\frac{3}{2}.E}$ = _____ miles to the horizon

9. The Twin Lights were replaced by _____

10. Why aren't the lights really "twins"? _____

_____

REFERENCE MATERIALS

Vocabulary--WAVES

Beaufort scale - a scale of numbers that relates the speed of the wind to the size of waves observed on the open ocean.

breaker - a wave in which the crest has fallen off.

crest - the uppermost part of a wave.

feeling bottom - when waves move into water shallower than ½ their wave length causing the lower part of the circular motion of the water particles to slow down due to friction with the bottom.

fetch - the distance of water over which the wind can blow. One of three factors that determine the size of wind waves.

littoral drift - the movement of sand along a beach because of longshore current.

longshore current - current of water that moves along a beach caused by waves breaking at an angle with the shoreline.

plunging breaker - a breaker in which the crest is thrown off into the trough ahead.

rip current - water current formed when water moves to sea through a break in an offshore bar.

spilling breaker - a breaker in which the crest slides down itself into the trough ahead.

surging breaker - a breaker in which the crest does not fall over into the trough ahead.

swell - a wave that has moved out from under the wind that formed it.

trough - the low area of a wave between two crests.

tsunami - a seismic wave that may reach great heights. Giant sea waves caused by earthquakes, volcanic explosions, and other disturbances of the sea floor.

wave height - the vertical distance between a wave trough and a wave crest.

wave length - the horizontal distance between two crests.

wave period - the time that elapses between the passing of two wave crests.

wave refraction - the bouncing of waves off the shore or other obstructions. The angle of reflected waves depends on the angle of the approaching waves.

wave diffraction - the curving of waves when they pass between obstacles.

Vocabulary--TIDES

Apogee - the point in an elliptical orbit where the orbiting object is at the greatest distance from the object being orbited.

Centrifugal force - outward force exerted by a revolving body away from the center of revolution.

Diurnal tides - a tidal cycle of one high and one low tide about every 24 hours and 50 minutes, one lunar day.

Ebb tide - the tide associated with the decreasing height of the tidal cycle, the outgoing tide.

Flood tide - the tide associated with the increasing height of the tidal cycle, the incoming tide.

Gravity - the attractive force which masses exert on each other.

Lunar day - the amount of time it takes the earth to rotate so that the same spot on the earth is lined up with the moon before and after the rotation, about 24 hours and 50 minutes.

Mean low tide - the average height of the water at low tide.

Neap tides - tides that have the least variation of water level between high and low. Neap tides occur when the sun, earth and moon form a right (90 degree) angle with each other i.e. when the moon is in its quarters.

Perigee - the point in an elliptical orbit where the orbiting object is at the least distance from the object being orbited.

Semidiurnal tides - a tidal cycle of two high and two low tides about every 24 hours and fifty (50) minutes, a lunar day. There is little difference in the magnitude of two successive high and low tides.

Slack tide - the state of the tide when tidal current velocity is near zero.

Spring tides - tides that have the greatest variation of water level. Spring tides occur when the sun, moon, and earth form a straight line, with a full or new moon.

Tidal currents - movements of water in response to the tides.

Intertidal zone - that part of a coastline that is underwater at high tide and exposed at low tide.

Mixed tides - semidiurnal tides that have a difference in the magnitude of successive high and low tides.

- Coastal Geology

Vocabulary

Barrier Island: An island separated from the mainland by a narrow body of water or by a shallow, often marshy area.

Estuary: The place where a river meets the sea.

Inlet: An opening in a barrier island that connects the sound or the lagoon with the ocean water.

Marsh: An area of soft wet land periodically flooded by the tide, typically found in a low wave energy area behind an island or in estuaries.

Spartina: A hearty, salt-tolerant grass.

Dune: A mound of sand built by the force of the wind.

Overwash or Washover: A process whereby waves washing over an island carry sand from the sea side to the land side.

Blowout: For sand dunes it refers to the situation when winds move sand to create an unstable moving dune in an area previously stabilized by plants.

Beach: That portion of the shoreline from the berm to the nearshore sand bars.

Berm: A terrace of sand found at the highest tide point where waves have either deposited sand or eroded a little cliff.

Jetty: A structure built to influence the movement of currents in order to maintain channel depths at the entrance to harbors.

Longshore Current: The current in the surf zone moving parallel to the shore, which is generated by waves breaking at an angle with the shoreline.

Littoral Transport: The longshore current carries sand along the shoreline, and may deposit it at one end of an island, thereby extending that end.

Bar: A submerged mound of sand.

Breakwater: A sea wall of rock, concrete, etc., built to absorb the impact of waves and thus protect the shore behind it.

Sound: The body of water that lies between an island and the mainland.

Spit: A small penninsula-like point of land projecting into the water from the shore.

Sediment: Small bits of worn away rocks and decayed organic materials that are transported by wind and water.

Coastal Ecology

Vocabulary

Nutrients: Chemicals needed to support plant and animal growth: the main plant nutrients are phosphorus and nitrogen.

Buoyancy: The tendency of an object to sink or float.

Ecosystem: A community of organisms interacting with each other and the environment in which they live.

Filter Feeder: Any organism which actively filters suspended material out of the water column by creating currents. Examples are oysters, herring, baleen whales.

Plankton: Small organisms which drift with the current.

Zooplankton: Tiny animals floating in the upper water column feeding on phytoplankton.

Phytoplankton: Tiny plants floating in the upper levels of the ocean where sunlight penetrates.

Bioluminescence: Light emitted from organisms by physiological processes. Luminescence in marine organisms is probably an adaptation for recognition, swarming and reproduction.

Photosynthesis: A process in plants by which energy - rich organic compounds are made from water and carbon dioxide using sunlight as an energy source.

Productivity: The amount of organic material formed in excess of that used for respiration. It represents food potentially available to consumers.

Diatom: A single-celled organism that is a type of plankton. Diatoms are one of the most nutritious food sources for animals in the sea.

Dinoflagellate: A single-celled organism that is a type of plankton. Nearshore plankton caught with plankton nets are mostly diatoms and dinoflagellates.

Nekton: Actively swimming animals, such as fish.

Benthos: Organisms living on the bottom of the ocean, eg. crabs and worms.

Benthic: Having to do with the ocean bottom.

Dessication: The tendency to dry up when removed from water for a period of time; this factor is extremely important for sea-dwelling crustaceans (ghost crabs, sand fleas, etc.) which must return to the ocean for water--these animals need water to moisten the gill-like lungs which they possess.

Littoral: Referring to the region along or near the shoreline. The intertidal zone.

cont.

Fauna: The animals of a given region.

Epifauna: Animals living on the ocean bottom, either attached to it or moving freely over it, such as crabs.

Infauna: Animals which burrow into sand or mud, such as clams.

Vertebrate: An animal that has a backbone or spinal column.

Invertebrate: An animal that does not have a backbone or spinal column.

Biota: Plants and animals of a given region.

Niche: The position of an organism in its community, defined by what it does (its profession -- herbivore, carnivore, scavenger, etc.)

Substrate: The base on which a plant or animal lives. For example, barnacles attach to hard substrates like pilings while lugworms prefer soft substrates like sand flats.

Zonation: The distribution of organisms typical of a particular area.

Brackish: Less salty than the ocean, but saltier than fresh water; estuaries are brackish because fresh river water mixes with salty ocean water.

Habitat: The particular place where an organism lives; salt marshes are one kind of habitat, beaches another.

HINTS ON WRITING POETRY

Anyone can write poetry. All that's needed is an experience you feel strongly about, some expressive words and a format or style to follow. Poetry should follow certain rules to make it more meaningful.

Poems can be rhyming or free verse. Two other simple, but expressive types are Haiku - a Japanese style, and Cinquain - from the Spanish word for five.

First decide what topic or experience you wish to write about. Spend some time thinking of 10 or more adjectives and verbs that best describe your feelings. Sometimes it's best to do this in a group. Now try your hand at it.

1 - Rhyming and free verse can be difficult forms of poetry. Work with others on your word list and words that rhyme with them. Look for familiar poems that are good examples.

Example: Harry was a hermit crab,
Whose shell was white as snow.
And everywhere that Harry went,
His seashell was in tow.

2 - Haiku is from the Japanese. The lines don't need to rhyme because the emphasis is on syllables. Haiku is three lines containing

Five syllables,
Seven syllables, and
Five syllables each.

Example: The fog shrouded beach
Shining from sentinal's light
Giant waves rush in.

3 - Cinquain is also based on syllables, having five lines and a set number of syllables.

Title:	2 syllables
Description of the Title:	4 syllables
Description of an action:	6 syllables
Description of a feeling:	8 syllables
Another word for the Title:	2 syllables

Example: Ocean

Graceful, flowing
Sailing her boundaries
Sadly finding final landfall
Peaceful

4 - If you have mastered simpler forms of poetry, you might want to try writing a diamante - poem that is diamond shaped.

In a diamante you can demonstrate how two words with opposite meanings can be associated with each other by related words. Think of opposites that might be good topics for a diamante... Spring-Autumn, Sea-Land, Birth-Death, City-Forest...

noun
adjective adjective
participle participle participle
noun noun noun noun
participle participle participle
adjective adjective
noun

Example:

Spring
bright young
blooming growing starting
warmth beauty life hope
moving sleeping finishing
crisp shady
Autumn

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